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On the Metamorphosis of a Clupeoid Fish, *Pterothrissus gissu* Hilgendorf[1)]

Kiyomatsu Matsubara

(Received June 1, 1942)

On January 20, 1940 and March 4, 1942, leptocephalid larvae were caught, amongst others, by a deep-sea trawler operating 25 miles south-east to Tyôsi, Tiba Pref., on muddy bottom, at a depth of 125 fathoms. They amounted to 110 in number and bore close resemblance to those of a clupeoid fish, *Albula vulpes* (Linné) at first glance. Upon careful examination of 36 more or less complete specimens, the writer has come to the conclusion that they all represent various degrees in development of one species which is referable to a clupeoid fish, *Pterothrissus gissu* Hilgendorf, at least in the following features: 1) dorsal provided with 51 to 63 rays (56 to 65 in adult of *P. gissu*); 2) myotomes numbering 101 to 107 on sides of body (about 109 in the adult); 3) dorsal fin extending gradually forward until the first ray is fixed above the 15th myotome as is the case with the adult; 4) ventrals fixed in most of the specimens on 39th or 40th myotome as in the adult; and 5) mouth gradually directed downward as the larvae metamorphose into young.

It goes without saying that nothing whatever could be known of the age of the specimens at my disposal. Yet, the paramount importance to find any means which would put the whole lot to a progressive series is obvious. It should be mentioned in this connexion that the dorsal fin continues forward extension up to the end of metamorphosis. Thus the decreasing number of myotomes in front of the fin may be taken as a clue which indicates advancing biologic age of the specimens. In the present paper, the number of pairs of anterior myotomes which include those situated in front of the dorsal fin and one just under the first ray of it is exclusively used for such purpose and abbreviated as *ant. myot.*

The specimens cover a range of 35 degrees in the development, i.e., 35 in biologic ages. But when viewed generally 3 successive stages may be

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1) Contributions from the Biological Laboratory, Imperial Fisheries Institute, Tôkyô, and Zoological Department, Research Institute for Natural Resources, Tôkyô, No. 3.

recognized, namely (A) gradually increasing in the length of body, (B) gradually shortening in the same, and (C) immediately after the metamorphosis.

My observations may be summarized as follows:

1. *Length.* As already stated, the length of body first reaches a maximum and then passes through a minimum. The maximum lies at 131.5 mm in body length (150.7 mm in total length) whereas the minimum at 71.5 mm in body length (93.7 mm in total length) as well as at the end of the larval stage.

2. *Mouth.* In the youngest larva of stage A, which measures 109.5 mm in standard length and has 49 *ant. myot.*, both jaws are equal so that mouth opens anteriorly (Pl. 1, fig. 1). But, as development advances, the upper jaw grows gradually longer than the lower to cause the mouth directed toward the under-side of the snout.

3. *Shape, color and pigmentation.* The leptocephalus is extremely compressed and band-like in form with the caudal fin deeply forked, the lower lobe being always much longer than the upper. When fresh from sea, the body was transparent and the myotomes were distinctly visible with the naked eye.

The pigmentation first begins to appear on the basal region of caudal and upper side of head. In our youngest specimen (with 49 *ant. myot.*) these two regions are more densely covered by black pigments than anywhere else. On sides of head the black pigments make their appearance on suborbital region, and then on snout and opercular regions. In the youngest specimen the melanophores are few and scattered on suborbital region, but in specimens with 47 or 46 *ant. myot.* about 15 similar pigments are found crowded on each side of the snout, opercular and suborbital regions. On sides of body the pigmentation begins to appear along each myoseptum below the lateral median line, and then increases toward the back of the body. In a specimen with 49 *ant. myot.*, the black pigments are sparsely set in a single series on each myoseptum below the lateral median line, but they extend to the dorsal median line in specimens of early B-stage. Further, the black pigments on myotomes are found to exist at least in specimens with 40 *ant. myot.* One more or less large black pigment is always present at each base of dorsal and anal rays on both sides. A row of black pigments which are already visible on each side of the alimentary canal in our youngest specimen entirely disappear when the metamorphosis is accomplished. Fins are uniformly pale in our youngest larva (49 *ant. myot.*), but the small black pigments begin to appear on entire caudal and on upper half of the pectoral fin at the end of A-stage, and similar ones appear on anterior half of the

dorsal and on both whole ventral and anal at the begining of B-stage. The posterior half of the dorsal fin remains unpigmented down to the stage with 32 *ant. myot.*, but all the fins are uniformly covered with black pigments when the fish passed through the metamorphosis into young stage.

4. *Fin rays.* The species-specific numbers of the fin-rays are already taken up by specimens of early stages. Such numbers are seen in the anal and ventral rays of the youngest specimen of mine which has 49 *ant. myot.* It may be mentioned that a young larva with 47 *ant. myot.* has species-specific number of pectoral fin-rays. Such a larva was found possessing 60 dorsal fin-rays and some larvae a little older than this were seen provided with 56 or a little more ones whereas the adult has usually 56 to 65 corresponding rays. The reader is referred to Fig. 1 for further details.

5. *Number of the myotomes.*

a. Total number of the myotomes on sides of the body (Fig. 1 E): According to my observation on two specimens the lateral muscle is composed of 109 myotomes in the adult. In 36 specimens, including 34 leptocephali and 2 which just passed through the metamorphosis into young stage, the myotomes are found fluctuating form 101 to 107 in number exclusive of the undifferentiated muscualr part immediately before the base of the caudal fin, and no significant differences in number were discernible in accordance with the stage of the fish. Such being the case, it seems to me very probable that the muscle immediately before the base of caudal differentiates into 2 or 3 myotomes either at the end of B-stage or the begining of C-stage.

b. Number of the myotomes before the base of pectoral (Fig. 1 F): The characteristic number of the myotomes in front of the base of pectoral including the one at the base of the pectoral is usually 5 in the present species. The larvae fix the fin at this species-specific position so early at the stage with 46 *ant. myot.*

c. Number of the myotomes before the base of ventrals (Fig. 1 G): The number of myotomes before the origin of the ventrals is mostly 39 or 40 in all the present larvae as in the adult. It is very probable, therefore, that the ventrals are fixed at their particular position earlier than any other fins.

d. Number of the myotomes before the end of base of dorsal (Fig. 2 A): Base of the dorsal fin gradually stretches posteriorly until the fish completely accomplish the metamorphosis, and consequently the number of the myotomes in front of the end of base of the dorsal fin gradually increases until the fish undergo the metamorphosis into the young stage.

e. Number of the myotomes before the insertion of the anal fin (Fig. 2 B): Origin of the anal fin shifts by degrees anteriorly, just opposite being the case with the end of base of the dorsal fin. Thus, the number of the myotomes before the insertion of the anal fin gradually decreases until the metamorphosis of the fish is accomplished.

f. Number of the myotomes before the end of base of the anal fin (Fig. 2 C): In number of the myotomes before the end of the base of the anal also a similar trend is prevailing as is the case with the former. It is worthy of mention that the base of the anal fin stretches merely anteriorly instead of being stretched both anteriorly and posteriorly as in the dorsal fin.

g. Number of the myotomes lying under the base of the dorsal fin (Fig. 2 D): The number of the myotomes lying under the base of the dorsal fin progressively increases until the end of B-stage. It is caused by stretching the base of the fin both anteriorly and posteriorly, whereas the dorsal rays are fixed in characteristic number of the species already in A-stage.

h. Number of the myotomes lying above the base of the anal fin (Fig. 2 E): The number of the myotomes lying above the base of the anal fin increases until the end of B-stage with the similar tendency as is the case with the former.

6. *Changes of the lengths of the various parts of the body in relation to the biologic age* (Figs. 3 to 7). Two defined tendencies in changes of the lengths of the various parts of the body are recognized in B-stage. Shortening occurs in body length (Fig. 3 A), depth (Fig. 3 B), distance from tip of the snout to the origin of the dorsal (Fig. 3 C), same from tip of the snout to the end of the base of the dorsal fin (Fig. 3 D), from tip of snout to the insertion of the ventral fin (Fig. 4 A), from tip of the snout to the origin of the anal fin (Fig. 4 B) and from tip of the snout to the end of the base of the anal fin (Fig. 4 C). But it should be mentioned that the length of the head (Fig. 4 D), depth and width of the same (Fig. 5 A · B), length of the snout (Fig. 5 C), diameter of the orbit (Fig. 5 D), interorbital width (Fig. 5 E) and the distance from tip of the snout to the insertion of the pectoral fin (5 F) gradually increase instead.

As plotted in Figs. 6 to 7, body length (Fig. 6 A), distance from tip of the snout to the end of the base of the anal fin (Fig. 6 B), same from tip of the snout to the origin of the anal fin (Fig. 6 D) and from tip of the snout to the origin of the dorsal fin (Fig. 6 F) decrease rather rapidly with similar trend as the age advances. Whilst the distance from tip of the snout to the end of the base of the dorsal fin (Fig. 6 C), same from tip

of the snout to the origin of the ventral fin (Fig. 6 E) and the depth of the body (Fig. 7 E) decrese very gradually. On the other hand, the distance from tip of the snout to the insertion of the pectoral fin (Fig. 7 A), length of head inclusive of (Fig. 6 G · 7 B), and exclusive of, the postorbital part (Fig. 7 C), length of the snout (Fig. 7 D), depth of the head (Fig. 7 F), width of the head (Fig. 7 G) and the interorbital width (Fig. 7 H) gradually increase hand in hand.

7. *Proportions of various parts of the body in relation to the body length* (Figs. 8 to 10). With the advance of the biologic age there are found to occur three different trends in proportions of various parts of the body to the body length in B-stage. The ratios of the length of the head (Fig. 8 A), depth of the head (Fig. 8 C), width of the head (Fig. 8 D), length of the snout (Fig. 9 A), interorbital width (Fig. 9 B), diameter of the orbit (Fig. 9 C) and the distance from tip of the snout to the origin of the pectoral fin (Fig. 10 B) decrese rather rapidly. Whilst the depth of the body (Fig. 8 B), distance from tip of the snout to the origin of the ventral fin (Fig. 10 A) and same from tip of the snout to the end of the base of the dorsal fin (Fig. 10 C) are nearly constant proportionally. But the distance from tip of the snout to the origin of the dorsal fin (Fig. 10 D), same from tip of the snout to the insertion of the anal fin (Fig. 10 E) and from tip of the snout to the end of the base of the anal fin (Fig. 10 F) increase gradually, not agreeing with the first case.

The writer wishes to express his hearty thanks to Professor Arata TERAO for his kind advices given him in the course of the present work. Acknowledgment is also due to Professor Keitaro UCHIDA, Mrs. Tatuo SATÔ and Masao WATANABE for their kindness extended in various ways.

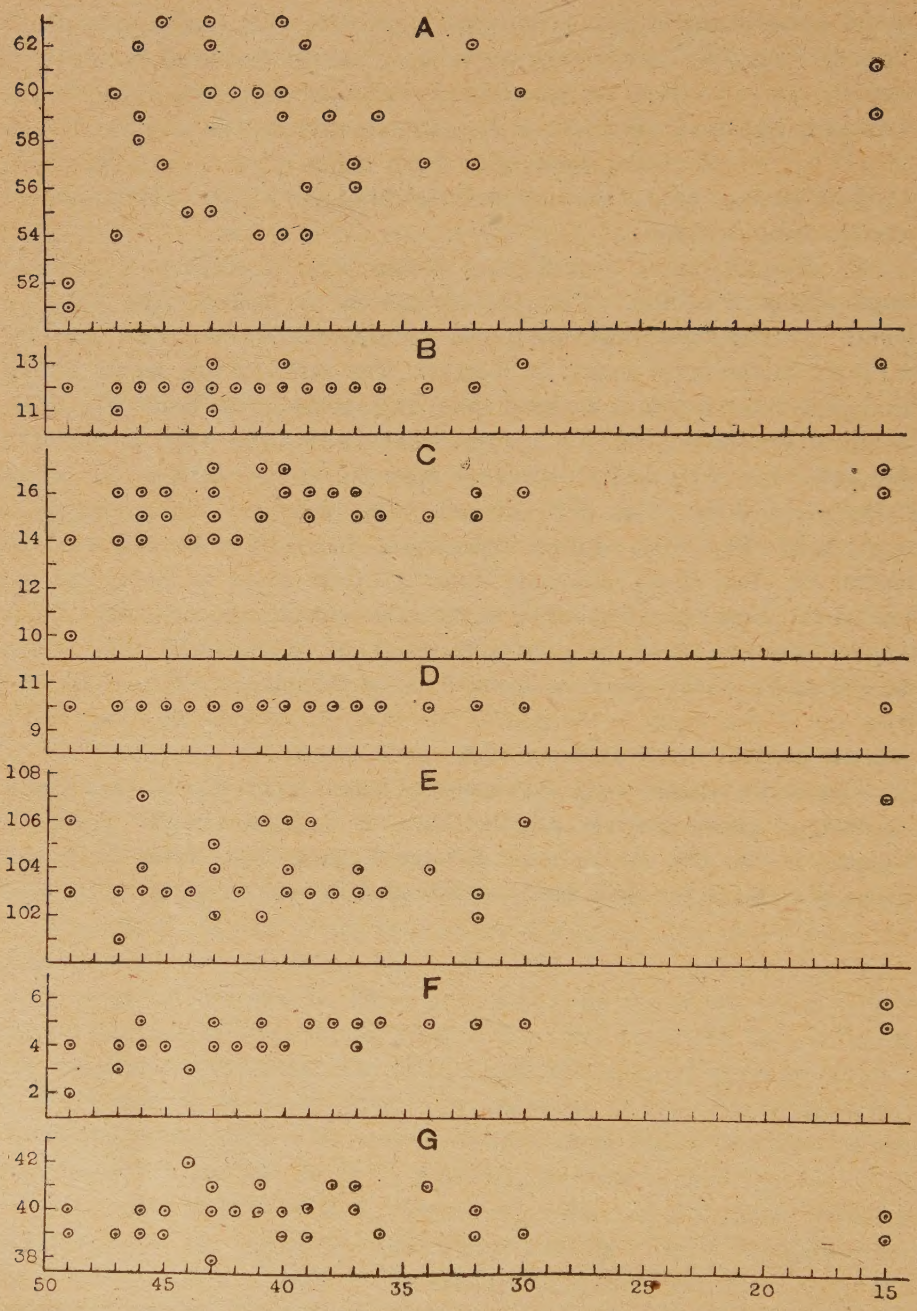

Fig. 1. Showing numbers of fin-rays and myotomes in relation to biologic age. *A*, dorsal rays; *B*, anal rays; *C*, pectoral rays; *D*, ventral rays; *E*, total myotomes on sides of body; *F*, myotomes before the base of pectoral fin; *G*, myotomes before the base of ventral fin.

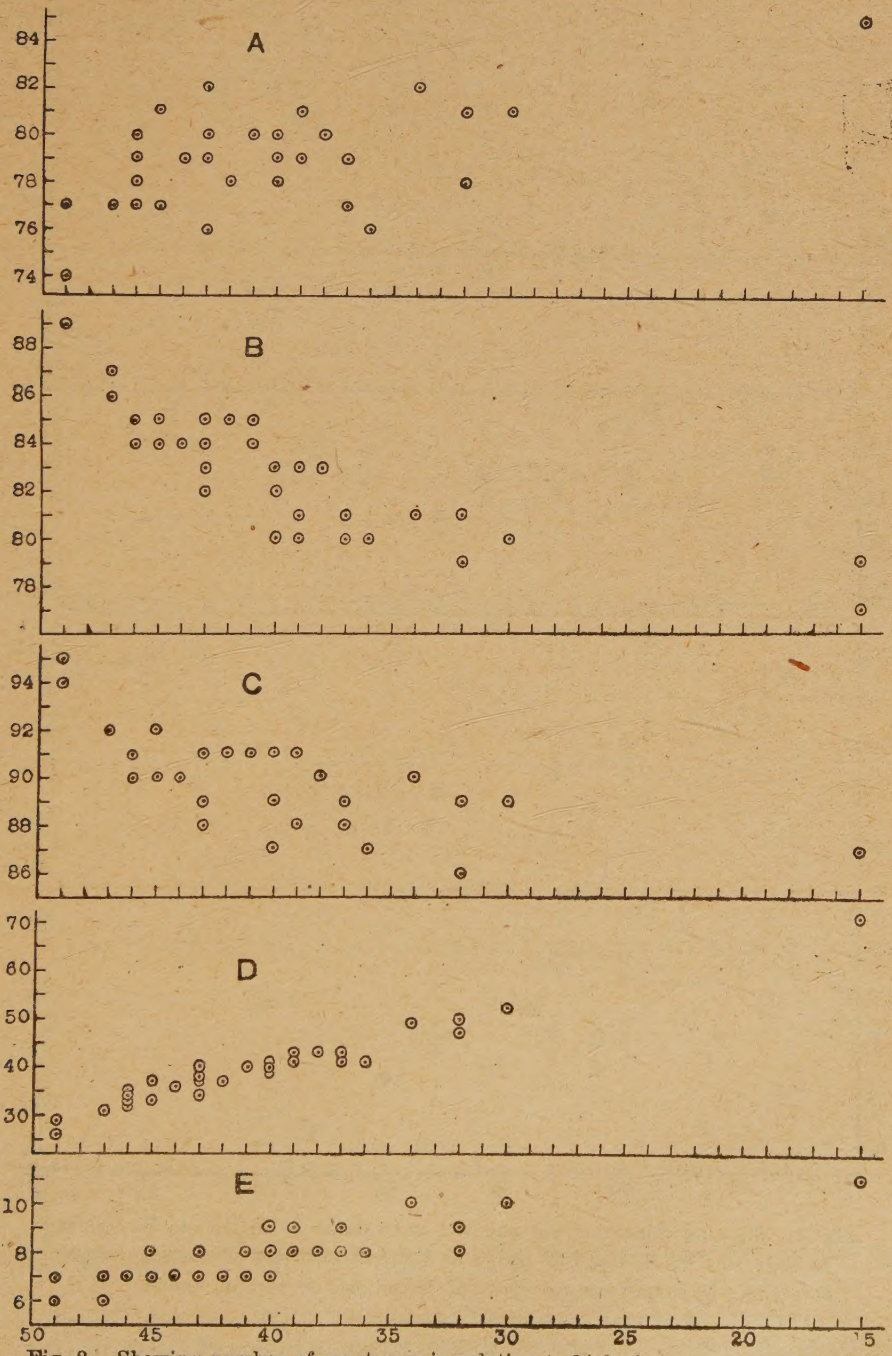

Fig. 2. Showing number of myotomes in relation to biologic age. *A*, before the end of base of dorsal; *B*, before the insertion of the anal fin; *C*, before the end of base of the anal fin; *D*, under the base of the dorsal fin; *E*, above the base of the anal fin.

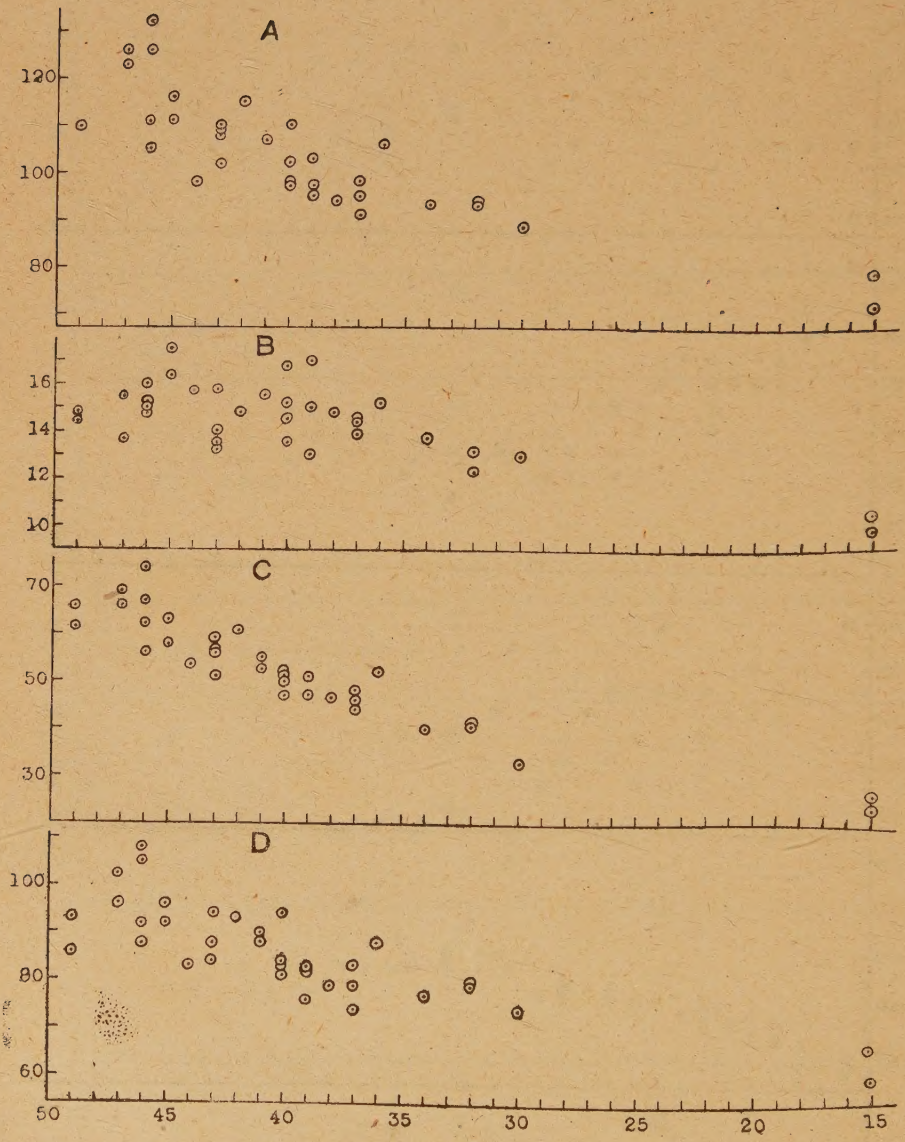

Fig. 3. Showing dimension (in mm) of body parts in relation to biologic age. A, body length; *B*, depth of body; *C*, distance from tip of snout to origin of dorsal fin; *D*, same from tip of snout to the end of base of dorsal.

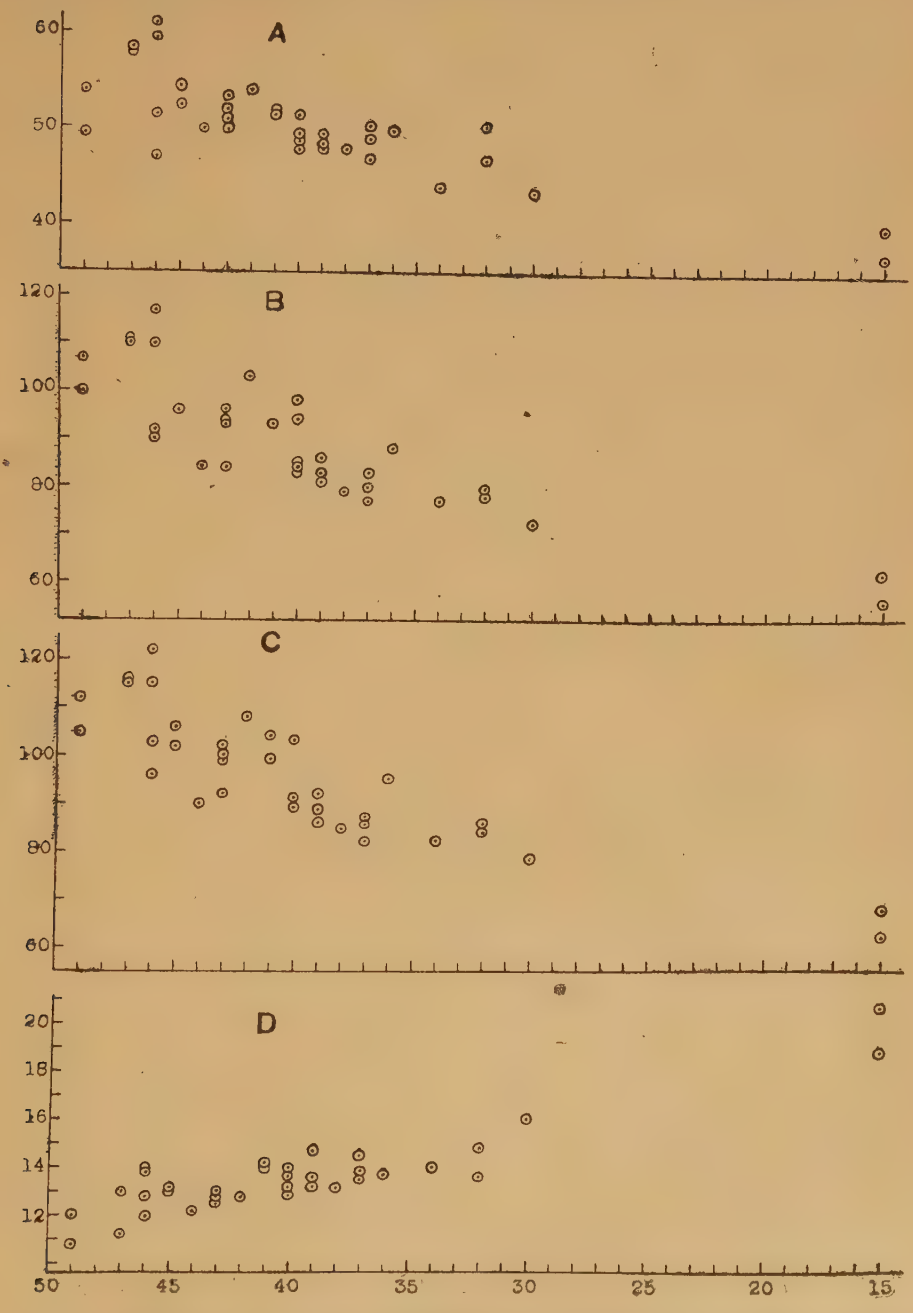

Fig. 4. Same as in Fig. 3. *A*, distance from tip of snout to the insertion of the ventral fin; *B*, same from tip of snout to the origin of the anal fin; *C*, from tip of snout to the end of the base of the anal fin; *D*, length of head.

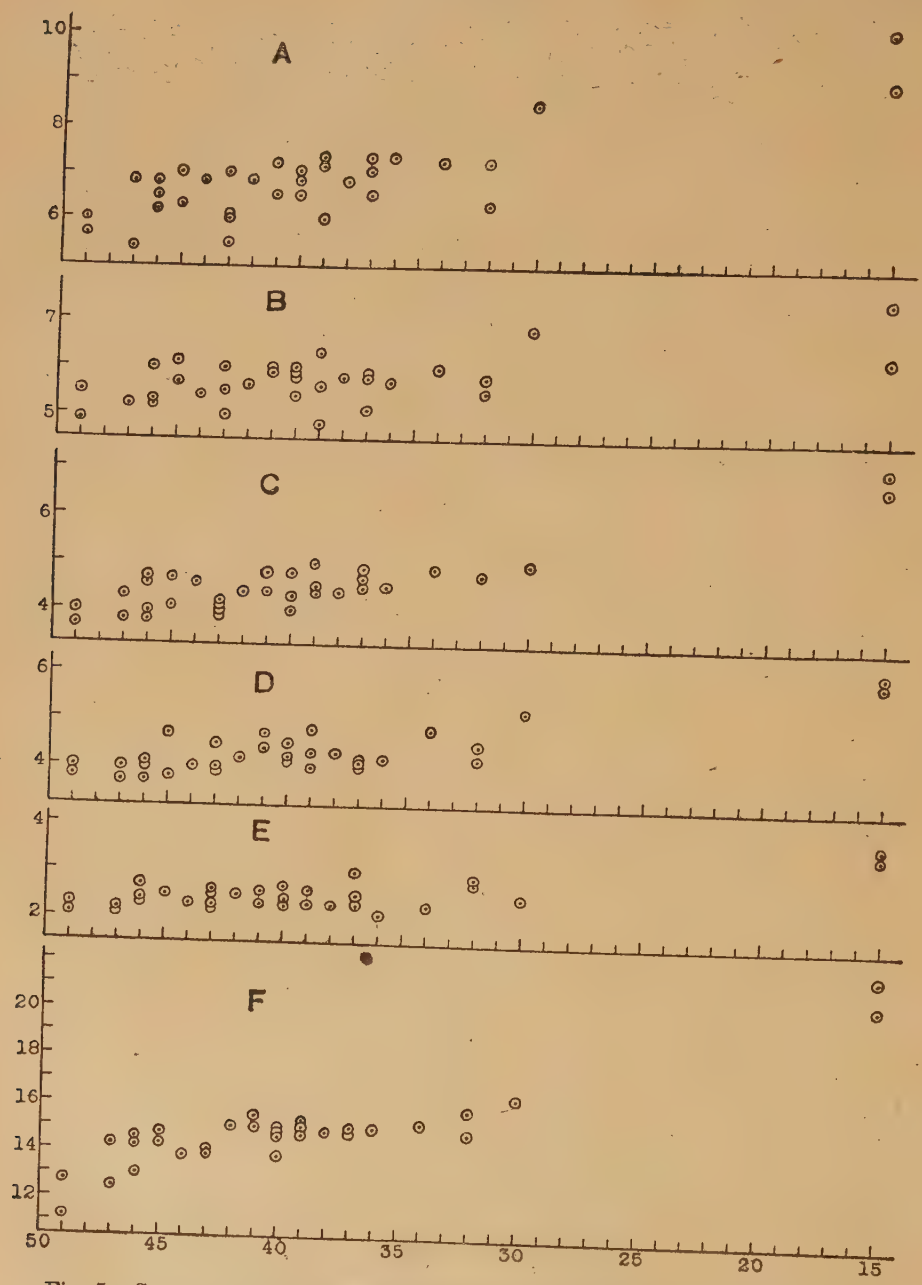

Fig. 5. Same as in Fig. 3. *A*, depth of head; *B*, width of head; *C*, length of snout; *D*, diameter of eye; *E*, width of interorbital space; *F*, distance from tip of snout to the insertion of pectoral fin.

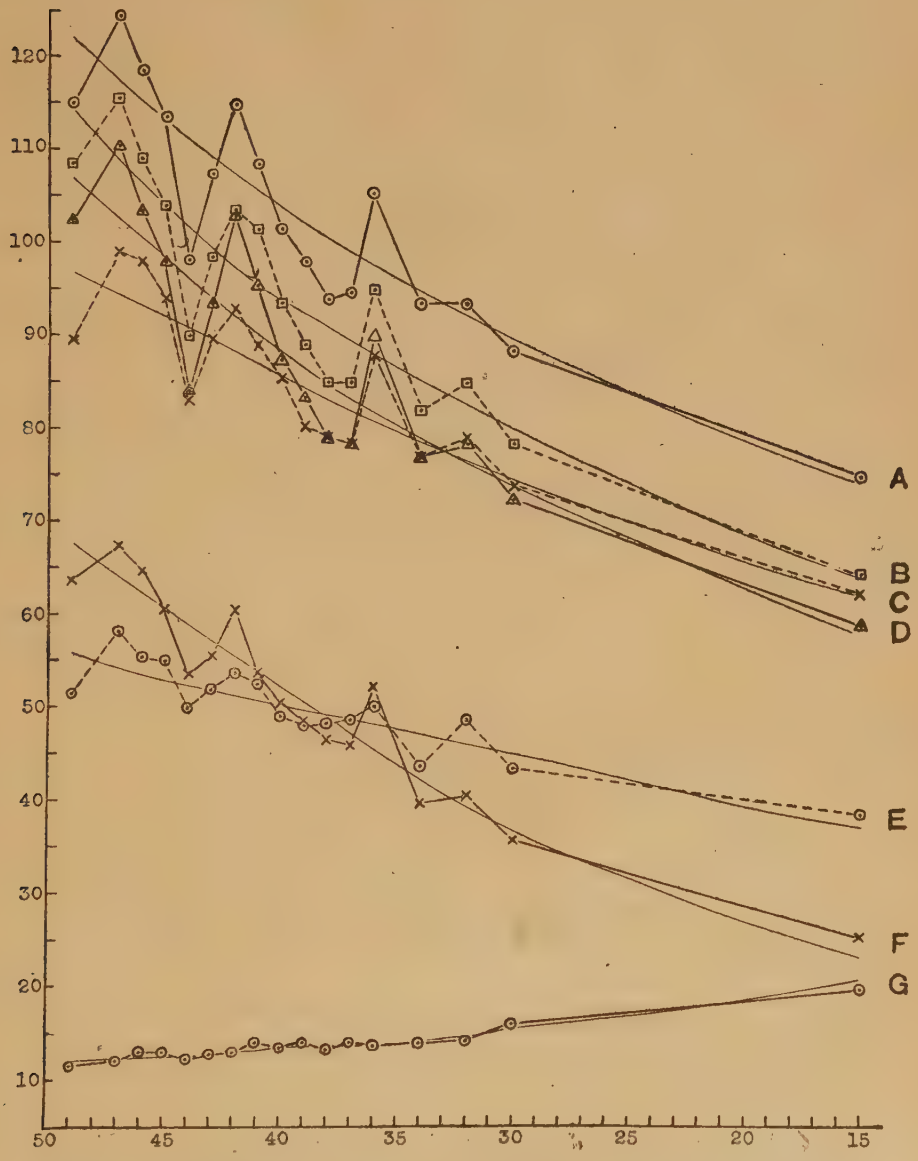

Fig. 6. Showing dimension (in mm) in average of body parts in relation to biologic age. *A*, body length; *B*, distance from tip of snout to end of base of anal fin; *C*, same from tip of snout to end of base of dorsal fin; *D*, same from tip of snout to origin of anal fin; *E*, from tip of snout to origin of ventral fin; *F*, from tip of snout to origin of dorsal fin; *G*, length of head.

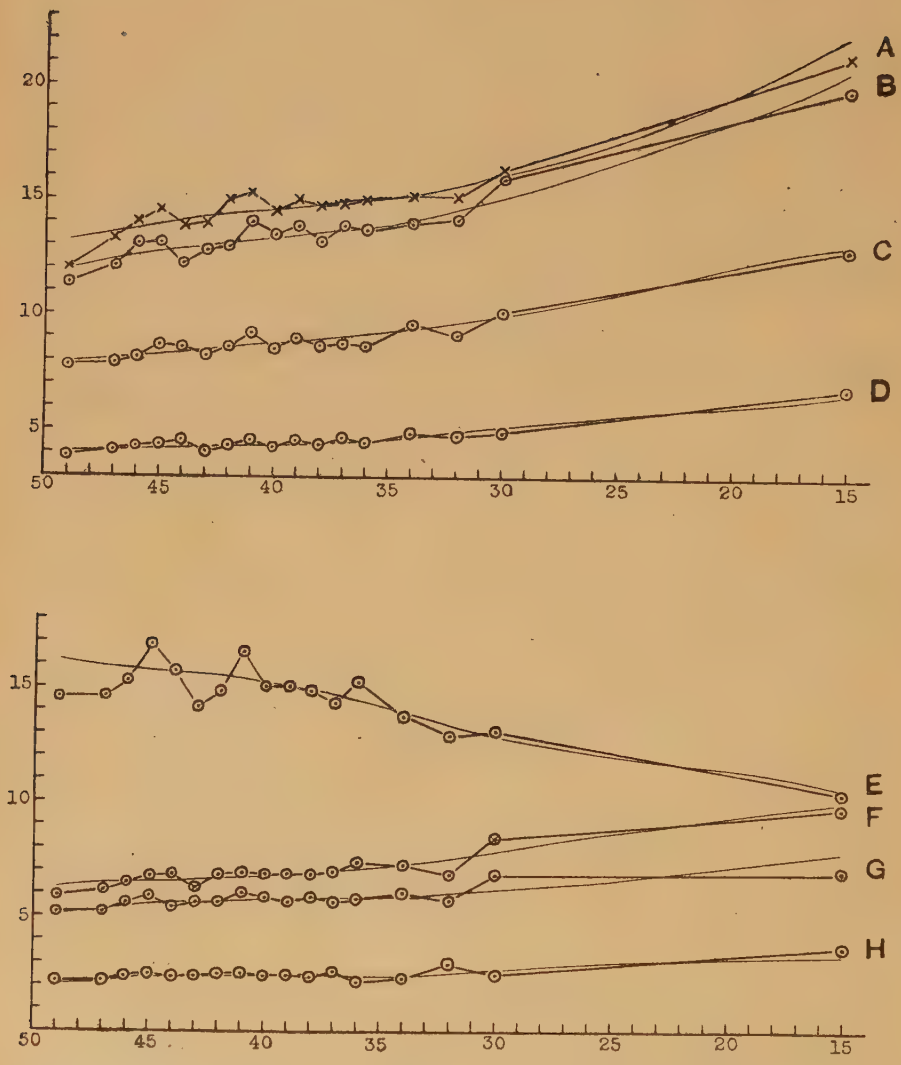

Fig. 7. Same as in Fig. 6. *A*, distance from tip of snout to the insertion of pectoral fin; *B*, length of head; *C*, length of head exclusive of the postorbital part; *D*, length of snout; *E*, depth of body; *F*, depth of head; *G*, width of head; *H*, interorbital width.

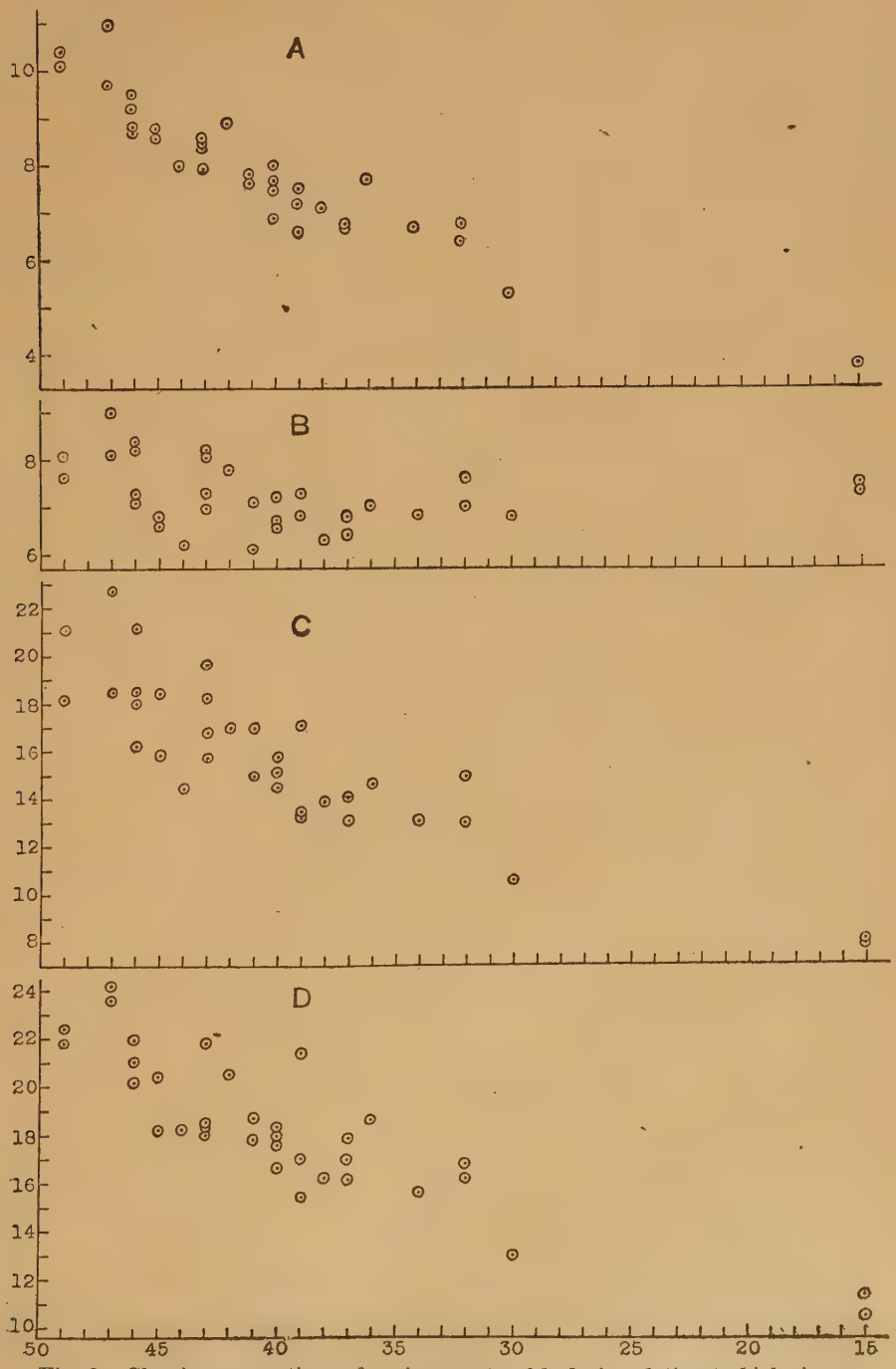

Fig. 8. Showing proportions of various parts of body in relation to biologic age. *A*, body/head; *B*, body/depth; *C*, body/depth of head; *D*, body/width of head.

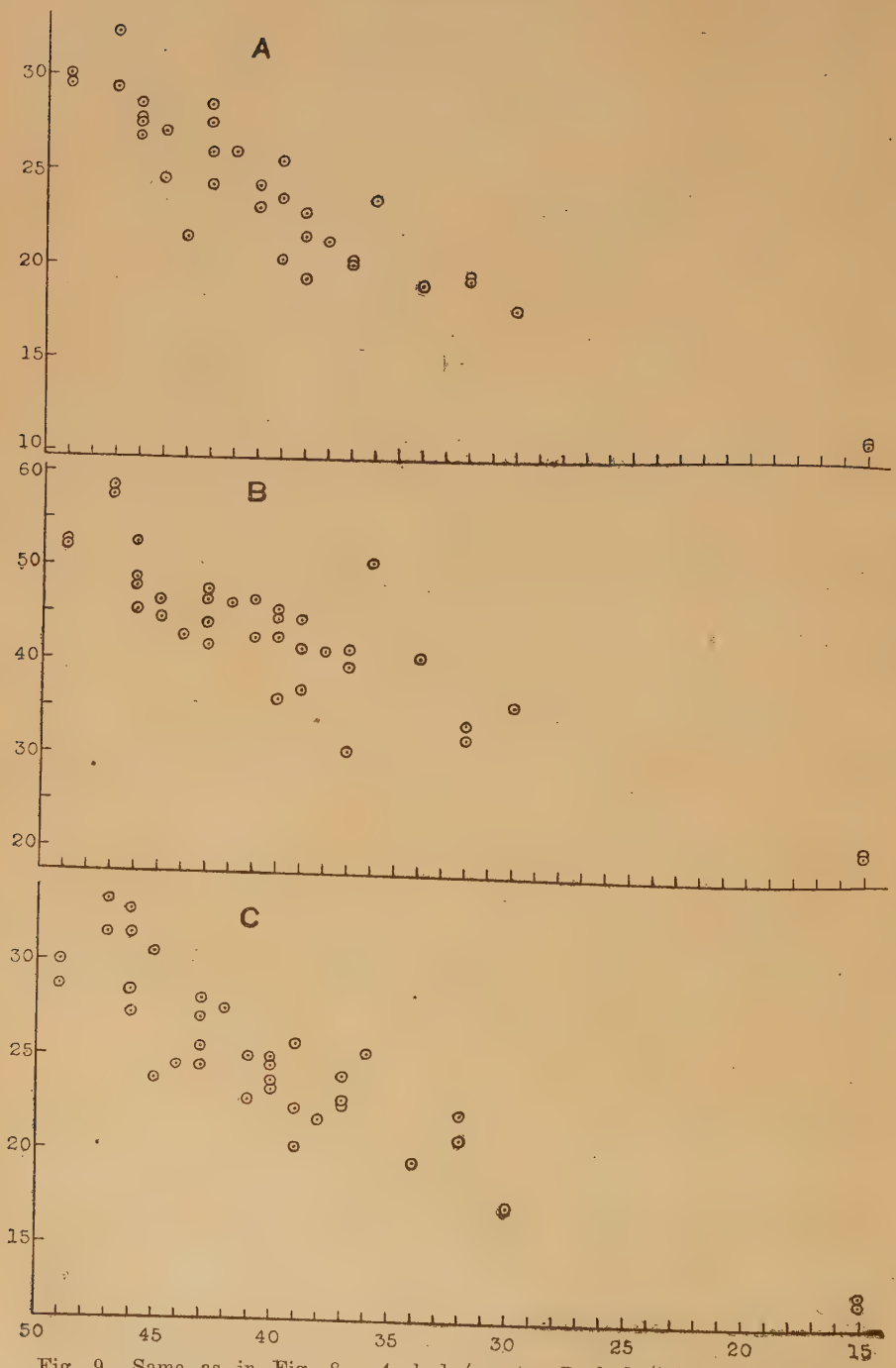

Fig. 9. Same as in Fig. 8. *A*, body/snout; *B*, body/interorbital width; *C*, body/diameter of eye.

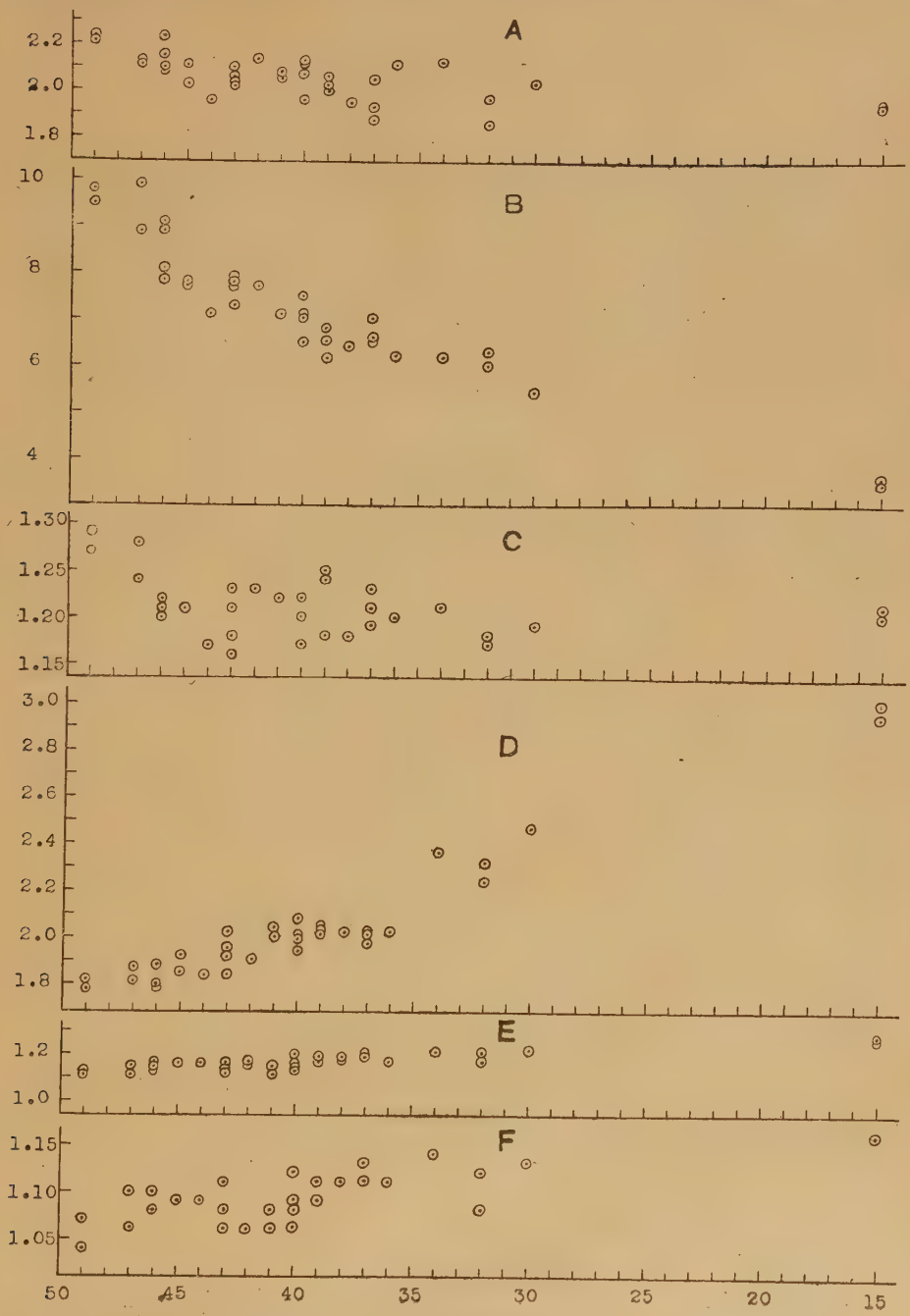

Fig. 10. Same as in Fig. 8. *A*, body/distance from tip of snout to origin of ventral fin; *B*, body/distance from tip of snout to origin of pectoral; *C*, body/distance from tip of snout to end of base of dorsal; *D*, body/from tip of snout to origin of dorsal; *E*, body/from tip of snout to origin of anal fin; *F*, body/from tip of snout to end of base of anal fin.

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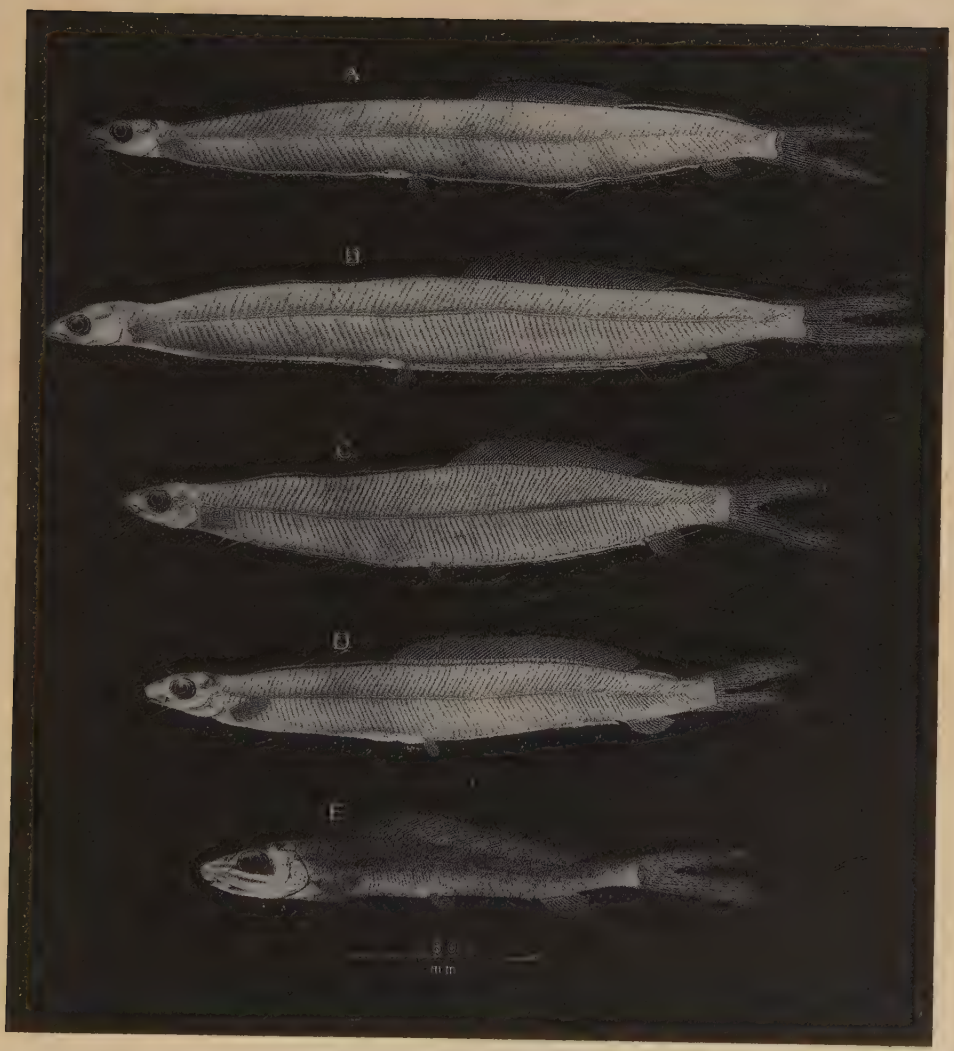
Explanation of plate

Various stages of the leptocephali of *Pterothrissus gissu* HILGENDORF.

1. Body length, 109.5 mm; total length, 131.7 mm; A-stage.
2. Body length, 126.0 mm; total length, 146.0 mm; A-stage.
3. Body length, 98.0 mm; total length, 121.2 mm; B-stage.
4. Body length, 92.8 mm; total length, 112.0 mm; B-stage.
5. Body length, 71.5 mm; total length, 93.7 mm; C-stage.


A
B
C
D
E

Studies on Japanese Palaemonoid Shrimps

III. *Leander*[1]

Ituo Kubo

(Received Jan. 9, 1942)

The present paper deals with, besides routine descriptions, sexual, geographical and age-variations of specimens with special reference to their mouth-parts, eyes, pleonic appendages, eggs and so forth, and puts, so far as possible, some comments on them.

Of twelve species which are dealt with in this paper, none was found to be new to science but two, viz., *Leander stylirostris* Yu and *L. gravieri* Yu, are new to the Japanese fauna.

It is with great pleasure that the author takes this opportunity of expressing his indebtedness to Professor Arata Terao for his invaluable help given in the course of this work. He wishes to express his warmest thanks to Dr. Yaichirô Okada, Dr. Tamezô Mori, Professors Nobutaka Nakai and Tadasi Tamura, Mr. Hirosi Yoshida, Mr. Takaharu Yamamoto, Dr. Katsuzô Kuronuma and Mr. Isao Matui for kindly placing material from various localities at his disposal.

I. External characters in general

The 12 species dealt with in this paper, viz., *L. paucidens* (de Haan), *L. serrifer* Stimpson, *L. pacificus* Stimpson, *L. macrodactylus* (Rathbun), *L. longipes* Ortmann, *L. japonicus* Ortmann, *L. carinatus* Ortmann, *L. longicarpus* Stimpson, *L. miyadii* Kubo, *L. gravieri* Yu, *L. stylirostris* Yu and *L. modestus* Heller, are all provided with well developed rostrum which is serrated on both upper and lower borders with spines, variable in number as given Table 1. More than 10 spines are mostly found in *L. serrifer*, *L. macrodactylus* and *L. gravieri* on upper rostral border (excluding apical

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(1) The expense of the present study was partly defrayed by the research fund from "Nippon Gakuzyutu Sinkôkai" (Foundation for the Promotion of Scientific and Industrial Research of Japan).

In the present paper, the length of body is indicated by a measurement from the posterior margin of orbital notch to the terminal margin of telson; total-length is measured from tip of rostrum to distal margin of telson; carapace-length is represented by the distance between post-orbital and distal margins.

ones), but less than 10 are present in others. Common to all the species is the existence of spines less than 10 on lower rostral border. As regards the rostral shape, three types may be recognized: (1) type-*A*, rather short,

Table 1.

Number of rostral spines.

Items / Specific name	Upper				Lower		Number of specimens examined
	Proximal		Apical				
	Range	Mode	Range	Mode	Range	Mode	
L. paucidens	4~8	6			1~4	2	265
L. miyadii	5~7	6				2	10
L. serrifer	9~13	11			3~4	3	33
L. pacificus	6~11	8	2~3	2	2~6	4	326
L. macrodactylus	10~13	11			3~5	4	136
L. gravieri	12~17	14	1~2	2	5~6	6	10
L. longipes	7~9	8	2~3	2	7~9	8	12
L. longicarpus	4~6	5		1	5~7	6 or 7	18
L. modestus	6~8	7			2~4	4	6
L. japonicus	7~10	7	0~1	1	5~8	5	14
L. carinatus	6~9	7	0~1	1	3~6	5	64

nearly horizontally straight; (2) type-*B*, elongate, remarkably recurved upwards; (3) and type-*C*, elongate, and provided with dorsal basal crest. The type-*A* is the most primitive of all, the type-*B* rather developed and type-*C* is the most highly differentiated. The type-*A* is seen in those five species, namely, *L. paucidens*, *L. serrifer*, *L. macrodactylus*, *L. miyadii* and *L. pacificus*. The type-*B* is represented by only three species, viz., *L. longipes*, *L. longicarpus* and *L. gravieri*. On the other hand, the following four species, *L. japonicus*, *L. carinatus*, *L. stylirostris* and *L. modestus* belong to type-*C*.

The abdominal terga are dorsally rounded in all the species with one exception, *L. carinatus*, in which third to sixth terga are distinctly carinated along the median line. Inferior margins of all the pleonic pleura are rounded.

Telson (Fig. 29, *A*~*K*) is shorter than the uropods. The dorso-lateral margins are armed with two pairs of setae in about distal half. Two types may be recognized in the shape of telson, viz., (1) *paucidens*-type, subrectangular in outline, but gradually reducing its width posterioly, with distal margin angulated, minutly pointed at middle and provided with two pairs of outer shorter and inner longer bristles and (2) *styliferus*-type,

tapering, acutely pointed, armed with two pairs of setae on the subterminal lateral margins. The first type appears to be more primitive than the second. A serial change from the first to second was observed in the telson of *L. styliferus* by KEMP (1917, pp. 216~217), and nearly the same gradation was ascertained by me in *L. japonicus* (Figs. 14 and 29, *K*). The first type comprises the majority of the species which are dealt with in this study, viz., *L. paucidens, L. pacificus, L. serrifer, L. macrodactylus, L. longicarpus, L. longipes, L. modestus, L. stylirostris* and *L. gravieri*, but the other includes only two species, *L. japonicus* and *L. carinatus*.

Eye (Fig. 24, *A*~*K*) is moderate in size and corneal region is well pigmented. Ocellus which is partly confluent with the cornea is present in all species excluding *L. stylirostris*.

Upper posterior margin of the cornea bulges out in all species both inner and outer lobes which are scarcely developed in *L. stylirostris*. *L. japonicus* and *L. carinatus* stand apart from other species in having slender appearance of eye in upper aspect, viz., the ratio of the total length against the width measured in the widest corneal region is larger than 1.6, instaed of being smaller than 1.5. Remarkably enough, *L. stylirostris* has no ocellus and hardly developed corneal lobes.

Mouth-parts: The mandible (Fig. 19, *A*~*K*) is Y-shaped, having molar and incisor processes and provided with a three-segmented palp. The incisor one is armed with four teeth along its distal margin without exception. The maxillula (Fig. 19, *L*~*V*) is cross-shaped. The inner lacinia is rather broad and distally recurved inwards. The outer lacinia is as large as the inner one, fringed rather thickly with bristles along its distal margin. The endopodite is a trifle slenderer than other two laciniae, projecting outwards opposite the inner lacinia, and provided with a rather large appical lobe. The maxilla (Fig. 20, *A*~*M*) carries an ear-shaped exopodite fringed with rather long feathered hairs along its entire margin. The endopodite is papilla-like, bare and unsegmented. The inner proximal endite is absent, but the distal one is well developed, rather slender and bifid with two thumb-like lobes in distal half. All maxillipeds carries an exopodite. In the first maxilliped (Fig. 21, *A*~*M*), the inner two lobes are broad, and the distal one is somewhat larger than the proximal one. The endopodite slender, undivided. The basal outer lobe of the exopodite is rather broad. The second maxilliped (Fig. 22, *A*~*M*) is inverted J-shaped, with six joints. The basipodite and ischiopodite are fused. The meropodite is more or less longer than the basi-ischiopodite. The carpopodite is very short, about two-thirds times as long as wide. The protopodite is bent strongly backwards, so as its outer margin lie nearly parallel with basi-ischiopodite. The

dactylopodite is broad, about one-fourth times as long as wide, median margin provided with thickly set setae. The third maxilliped (Fig. 23, *A*~*G* and *N*~*Q*) is pediform, four-segmented. The antepenult segment or basi-ischio-meropodite is the longest of all, consisting of the appendage, and somewhat or considerably curved with concave margin towards the median line. The carpopodite is somewhat shorter than antepenult one, but somewhat longer than the last or pro-dactylopodite. The basal segment is, provided with an ear-shaped protuberance on outer margin. In the mouth-parts excluding the third maxilliped, almost no specific modification is observed. The third maxilliped is, however, remarkably slender in *L. longicarpus*. According to BORRADAILE (1917), the endopodite of the first maxilliped is two-jointed and the basipodite of the third maxilliped is not fused with ischio-meropodite in *L. serratus*. But it is not the case with Japanese species of the present genus, so far as my observations go.

Pereiopods: The first cheliped is slender, the shortest of all limbs. The second cheliped is stout, the largest and the longest of all legs. A careful invesitgation of the shape of the second chela (Fig. 25, *A*~*M'*) enabled the present author to make the following classification:—

A. Palm much longer than movable finger
  D. No tooth on both prehensile edges of both fingers ..... *L. longicarpus, L. miyadii.*
  DD. Provided with one or two teeth on prehensile edge of movable finger and one tooth on cutting edge of fixed finger ..... *L. paucidens, L. pacificus, L. serrifer, L. macrodactylus.*
B. Palm as long as, or slightly shorter, than movable finger ..... *L. longipes, L. modestus, L. gravieri.*
C. Palm much shorter than movable finger, armed with no tooth on both prehensile edges ..... *L. japonicus, L. carinatus.*

The third leg (Fig. 26, *A*~*M*) is somewhat stouter and more or less longer than the first one. Regarding the shape of the dactylus, four types may be distinguished, viz., (1) moderate; (2) rather long; (3) remarkably long and (4) enormously long and filamentous. The first group consists of *L. paucidens, L. pacificus, L. serrifer* and *L. longipes*; the second group embraces *L. macrodactylus, L. longicarpus* and *L. miyadii*, while the following four species, *L. gravieri, L. modestus, L. japonicus* and *L. carinatus* are included in the third group. *L. stylirostris* only belongs to the group (4). The fourth pereiopod intimately resembles the third one in general aspects, though somewhat longer than the third one. The fifth leg (Fig. 26, *N*~*W*) is closely allied to the fourth leg but longer and slenderer than the fourth one. It is worth mentioning that the leg in question is especially slender in such six species as *L. stylirostris, L. longipes, L. gravieri, L. modestus,*

L. japonicus and *L. carinatus*. The appearance of the dactylus almost corresponds to that of the third leg.

Pleopods: The endopodite (Fig. 27, *A*~*U*) of the first abdominal appendage is simply leaf-shaped in both sexes, but there is well-marked sexual dimorphism in it (Kubo, 1936), much longer in male even in such a small specimen 10 mm in carapace-length. Distinct sexual difference as already pointed out by Pesta (1918), Gurney (1923 and 1924) and Kubo (1937) also exists in the endopodite of the second abdominal appendage (Fig. 28, *A*~*S*).

Secial interest attaches to that of the second abdominal appendage from view point of phylogeny, since the appendix musculina of *L. paucidens* is very particular in configuration (Fig. 28, *A*), greatly resembling that of *Palaemon* as already studied by the present author (Kubo, 1937 and 1940).

The branchiae are arranged on each side of cephalothorax as exhibited in the Table 2 and Fig. 1. A pleurobranchia exists on each thoracic segment from the fourth to the eighth. Two arthrobranchiae (one is rudimentary) are found on the third segment. One podobranchia is present on the second

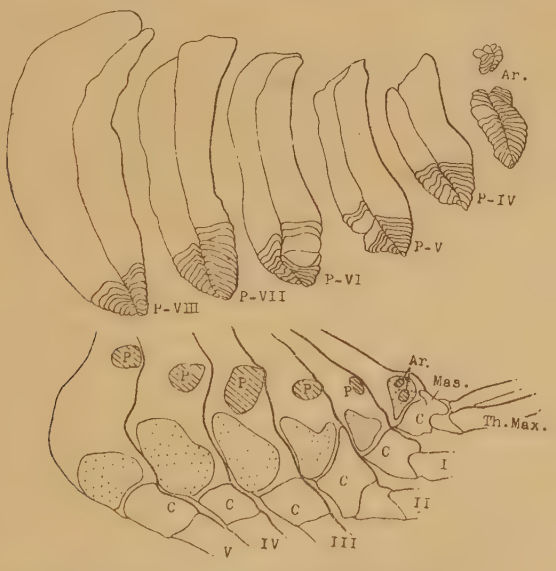

Fig. 1. Semidiagramatic showing of branchiae and a part of branchial chamber of *L. paucidens*. Ar., arthrobranchiae and their attachments on third thoracic segments; C, coxae; Mas., mastigobranchia; P, attachments of pleurobranchiae; P–IV~P–VIII, Pleurobranchiae removed from 4th to 8th thoracic segments; Th. Max., 3rd maxilliped. Roman numerals indicate the corresponding pereiopod and dotted areas articular membrane.

one, and a mastigobranchia is attached on the first (two-lobed) and second thoracic somite respectively. The branchial arrangement proved entirely the same as that of genus *Palaemon* (KUBO, 1941). It appears to me that the vestigial arthrobranchia attached on the third thoracic somite was overlooked by BATE (1888, p. 779).

Table 2.

Branchial arrangement of *Leander*.

Items	I	II	III	IV	V	VI	VII	VIII
Pleurobranchiae	—	—	—	1	1	1	1	1
Arthrobranchiae	—	—	1+r	—	—	—	—	—
Podobranchiae	—	1	—	—	—	—	—	—
Mastigobranchiae	1*	1	—	—	—	—	—	—

*, two lobed; r, rudimentary.

The eggs of *L. paucidens, L. miyadii, L. pacificus, L. serrifer, L. macrodactylus, L. gravieri, L. longicarpus, L. modestus, L. japonicus* and *L. carinatus* are subglobular in shape. The range and mean of both longer and shorter diameters of ten eggs removed from an alcoholic (about 70%) specimen of each species, are given in the accompanying table. Two groups are seen in the size of eggs: (1) large and (2) small. The eggs of the large size group measure, on average, 1.19~1.48 mm in longer diameter and 0.93~1.18 mm in the shorter one, the largest in those of *L. modestus*. This

Table 3.

Size of egg in mm.

Items / Specific name	Diameter				Body-length (mm) of mother shrimps from which the eggs were removed and locality.	
	Longer		Shouter			
	Range	Mean	Range	Mean		
L. paucidens	1.11~1.25	1.19	0.87~1.04	0.93	41.0	Nagano Prefecture.
L. miyadii	1.15~1.30	1.25	0.98~1.11	1.03	30.5	Harbin, Manchoukuo.
L. pacificus	0.57~0.66	0.60	0.46~0.53	0.50	39.0	Kominato, Tiba Prefecture.
L. serrifer	0.96~1.06	1.01	0.76~0.92	0.82	31.0	„ „
L. macrodactylus	0.53~0.63	0.58	0.41~0.48	0.44	32.5	Tokyô Bay.
L. gravieri	0.42~0.48	0.46	0.33~0.40	0.37	53.4	Gunzan, Tyôsen.
L. longicarpus	0.60~0.67	0.65	0.45~0.52	0.49	27.2	Iriomote-zima, Ryukyu.
L. modestus	1.42~1.56	1.48	1.13~1.25	1.18	37.0	River Rakutô, Tyôsen.
L. japonicus	0.52~0.58	0.55	0.41~0.46	0.44	35.0	Hukuyama, Hirosima Pref.
L. carinatus	0.70~0.81	0.75	0.53~0.60	0.58	69.0	Gunzan, Tyôsen.

group comprises only the eggs of three species, namely, *L. paucidens, L. miyadii* and *L. modestus*. On the other hand, the longer and the shorter diameters of those eggs belonging to the other group are, on average, 0.55～1.01 mm and 0.37～0.82 mm respectively. The latter group embraces those eggs of the other.

II. Phylogenical considerations

Those species examined in the present study are so closely related with each other in general configuration that one can not find any characters which would clearly point out the trend of the evolution of the animals in question. At any rate, anything available for such consideration are the following characters, viz., (1) number of rostral spines (2) shape of rostrum, (3) tip of telson, (4) pereiopods, (5) sixth abdominal somite and (6) appendix masculina. It appears to me, so far as my investigations go, that the following three off-shoots were given rise to from the *paucidens*-like hypothetical ancestor (Fig. 2). The first (A) comprises *L. paucidens, L. serrifer, L. macrodactylus, L. pacificus* and *L. miyadii,* and is characterized by having horizontally straight rostrum with many rostral spines on both upper and lower borders and telson with angulated tip. The second (B) off-shoot embraces three species, *L. longicarpus, L. longipes* and *L. gravieri,* and is more closely related to the first than to the third in general aspects. Long and recurved rostrum is common to this group. Four species, viz., *L. modestus, L. japonicus, L. carinatus* and *L. stylirostris* belong to the third. The third (C) is characterized by having crested rostrum, and styliform telson. The created condition is to be taken as the highest developed one since the rostrum of the specimens of the third group undergo gradual changes from straight *paucidens*-type (Kubo, 1939, p. 273, Fig. 2). The shape of telson of the third group is also finally attained by starting from the angulate *paucidens*-type. Further subdivisions of each group are dealt with in the descriptive part.

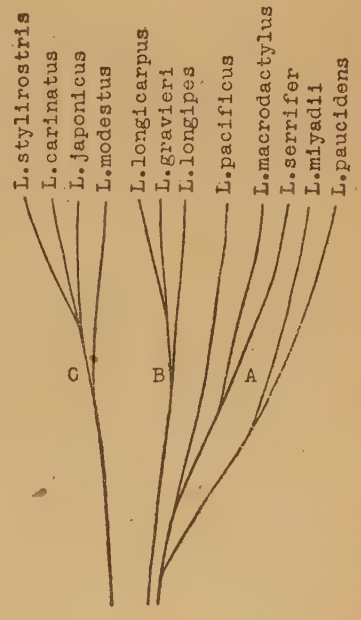

Fig. 2. Phylogenical tree of *Leander*.

III. Key to the Japanese species of genus *Leander*

A. Rostrum without basal dorsal crest.
  B. Rostrum moderate, a little shorter, or longer than, carapace.
    C. Rostrum armed with less than 10 spines on dorsal carina.
      D. Rostrum almost horizontally straight, provided with 4~8 spines (mostly 6) on dorsal carina; usually inhabits fresh water.
        E. Rostrum with usually one dorsal subterminal spine; appendix masculina large, about twice as long as stylamblys, fringed with rather thickly set setae along inner margin; abdomen with seven blackish brown cross bands; egg large, 1.11~1.25×0.87~1.04 mm...*L. paucidens* (DE HAAN).
        EE. Rostrum without dorsal subterminal spine; appendix masculina rather short, less than 1.5 times as long as stylamblys, fringed with setae on distal margin only; egg large, 1.15~1.30×0.98~1.11 mm .....*L. miyadii* KUBO.
      DD. Rostrum distally recurved upwards, armed with 6~11 (mostly 7 or 8) spines and two or three subterminal spines on upper border; appendix masculina slender, sparsly fringed with rather long setae; abdomen with many blackish brown corss bands; inhabits in brackish or salt water; egg small, 0.57~0.66×0.46~0.53 mm .....*L. pacificus* STIMPSON.
    CC. Rostrum provided with more than 10 spines on upper carina.
      F. Rostrum somewhat shorter than carapace; upper border horizontally straight (sometimes slightly recurved upwards at tip); second cheliped extends beyond antennal scale by at least entire chela.
        G. Dactyli of all ambulatory legs short, about one-third times as long as propodus in third leg .....*L. serrifer* STIMPSON.
        GG. Dactyli of all ambulatory legs long, about half times as long as propodus in third leg .....*L. macrodactylus* (RATHBUN).
      FF. Rostrum slightly longer than or as long as carapace, upper border almost horizontally straight or slightly convex in proximal half, but recurved upwards in distal half; second cheliped reaches beyond scaphocerite by about half of chela; dactyli of all ambulatory legs long, somewhat more than half of propodus in third leg .....*L. gravieri* YU.
  BB. Rostrum long, at least more than one and half times as long as carapace, remarkably recurved upwards.
      H. Rostrum with 7~9+2~3 (mostly 8+2) spines on upper border; second cheliped extends beyond scaphocerite by entire chela and about one-fifth of carpus, finger longer than palm, carpus a little longer than palm .....*L. longipes* ORTMANN.
      HH. Rostrum armed with 4~6+1 (mostly 5+1) spines on dorsal carina; second pereiopod reaches beyond scaphocerite by greater parts of chela, finger shorter than palm, carpus somewhat more than three times as long as palm .....*L. longicarpus* STIMPSON.
AA. Rostrum with basal dorsal crest.
  I. Eye with ocellus; fourth and fifth pereiopods normal in shape.
    J. Rostrum with one or two spines on upper apical border; telson tapering with acutely pointed tip; egg small, 0.52~0.81×0.41~0.60 mm; eye slender, 1.7~1.8 times as long as wide measured at the widest region of cornea; inhabits in brackish or salt water.

K. Abdomen dorsally rounded; carpus of second pereiopod about 1.4 times as long as movable finger ..... *L. japonicus* Ortmann.

KK. Abdomen dorsally carinated along median line from third to sixth segments; carpus of second pereiods 0.5~0.6 times as long as movable finger..... ..... *L. carinatus* Ortmann.

JJ. Rostrum without tooth on apex; telson with angulated tip which is armed with two blistles on each side; eye rather thick, 1.3~1.4 times as long as wide measured at the thickest region of cornea; egg large, 1.42~1.56×1.13~1.25 mm; inhabits usually fresh water ..... *L. modestus* Heller.

II. Eye without ocellus; fourth and fifth pereiopods unusually long and filamentous; rostrum twice or more as long as carapace; carpus of second pereiopods short, about one-fourth as long as merus ..... *L. stylirostris* Yu.

IV. *Description of species*

Genus ***Leander*** Desmarest. (emend)

Leander; Stimpson, 1860, p. 40; Ortmann, 1891, p. 513; Balss, 1914, p. 56; Pesta, 1918, pp. 111~112.

Palaemon, Rathbun, 1900, p. 125.

Body smooth, laterally compressed. Abdominal pleura rounded on lower margin, first and third overlapped by second. Rostrum well developed, usually serrated with many teeth on both upper and lower borders. Carapace provided with antennal and branchiostegal spines. Antennule carries two long flagella, the inner flagellum proximally uniramous but distally bifid with inner shorter and outer longer branches. Mandible Y-shaped with molar and incisor processes well defined, provided with three-segmented palp. Maxilla with ear-shaped exopodite, inner distal lacinia present, distally bifid with two lobes, but proximal lacinia absent. All maxillipeds with exopodite. Second maxilliped six-jointed. Third one pediform. First and second pairs of pereiopods chelate, the latter longer (usually the longest of all legs) and stouter than the former. Dactyli of the last three pairs of pereiopods simple. Endopodite of second abdominal appendage provided with slender stylamblys and appendix masculina in male but stylamblys only in female. Branchial system made up of five pleurobranchiae, one and one vestigial arthrobranchiae, one podobranchia and two mastigobranchiae as shown in the Table 2.

The present genus is closely related to the genus *Palaemon,* but it is easily discriminated from the latter by having the following characters:—(1) the second chelipeds are rather small, and (2) the carapace with branchiostegal spine but without hepatic spine.

Leander paucidens (de Haan)

Leander paucidens, Stimpson, 1860, p. 40; Doflein, 1902, pp. 639~640; de Man, 1907 p. 409; Balss, 1914, p. 58.

Palaemon paucidens DE HAAN, 1850, p. 170, Taf. 45, fig. 11; RATHBUN, 1902, p. 51.

Female: Rostrum lanceolate, rather broad, with lateral carina, slightly descending (Fig. 29, Lower), nearly reaching to distal margin of antennal scale, about 0.8 times as long as carapace; dorsal border somewhat convex, extending backwards almost to the middle of carapace, provided with six spines, of which the hindmost one situated on carapace, the foremost one placed near its tip; lower border rather strongly convex, armed with two spines near the middle. Carapace armed with well deveolped suborbital and branchiostegal spines. Abdomen dorsally rounded. Sixth abdominal segment nearly half as long as carapace, about 1.8 times as long as fifth abdominal somite when measured dorsally. Telson shorter than uropods, subrectangular in upper aspect, gradually reducing its width by half posteriorly, ratio of length against breadth between antero-lateral angles 4:1; each dorso-lateral margin armed with two bristles, proximal one near its middle and the other at posterior one-fourth; posterior margin minutely pointed at middle, fringed with two pairs of outer shorter and inner longer bristles which are twice as long as the former (Fig. 29, *A*). Eyes moderate, with hemispherical cornea which is slightly wider than stalk, about 1.3 times as long as wide, and with well developed inner and outer lobes (Fig. 24, *A*). Antennular peduncle shorter than rostrum, segmented into three; first joint depressed, broad, carrying a prominent spine on proximal outer margin, distal outer angle ending in a spiniform process which reaches a little beyond the middle of second segment; intermediate segment about twice as long as basal one (measured along inner margin) and about 1.7 times as long as wide; third one somewhat shorter than second one, provided with inner thinner and outer thicker flagella which are equal in length, about twice as long as carapace, outer flagellum proximally uniramous with about ten joints but distally bifid with inner shorter ramus comprising 26 joints and outer longer ramus (Fig. 24, *L*). Antennal scale rather broad, about 2.8 times as long as wide, outer margin almost straight, ending in a stout spine which does not reach to distal margin of lamella (Fig. 23, *H*). Third maxilliped extends beyond second antennal peduncle by half of last segment; proportions to pro-dactylopodite: penult segment 1.1, antepenult one 1.6; ultimate segment, penult and antepenult ones about 7, 6 and 7 times as long as wide respectively (Fig. 23, *A*). First thoracic limbs reach a little beyond distal margin of antennal scale; both fixed and movable fingers with no tooth on their inner edges; ratios against movable finger: palm 0.9, propodus 4, merus 3, ischium 2. Second chelipeds subequal in length, extend beyond antennal scale by entire chela, ratios to movable finger: palm 1.5, carpus 2.9,

merus and ischium 2.0; palm ca. 4 times, merus nearly 6 times as long as wide, fingers of chela have acute inturned tips, armed with a tooth on each cutting edge close to the articulation (Fig. 25, *A* and *A'*). Last three pairs

Fig. 3. Distribution of *Leander paucidens*. 1, Hurukamappu-numa, Etrohu-zima; 2, Kunasiri-zima; 3, Lake Abasiri; 4, Lake Mokoto; 5, Nemuro; 6, Sapporo; 7, Titose; 8, Hakodate; 9, Ôhata; 10, Nobedi; 11, Aisaka; 12, Lake Towada; 13, River Mogami; 14, Yamagata; 15, Murakami; 16, Lake Kizaki; 17, Lake Suwa; 18, Kasumigaura; 19, Satte, Saitama Prefecture; 20, Teganuma, Tiba Prefecture; 21, Yamaguti, Tokyo; 22, Komaba, Tokyo; 23, Lake Yamanaka; 24, Hakone; 25, Simoda; 26, Yosida, Siduoka Prefecture; 27, Lake Hamana; 28, Gihu; 29, Lake Biwa; 30, River Yodo; 31, Oki Isls. (Dôgo), Simane Prefecture; 32, Hukuyama, Hirosima Prefecture; 33, Tokusima; 34, Hukuoka; 35, Kumamoto; 36, Itiki, Kagosima Prefecture; 37, Genka, Okinawa-zima; 38, Genzan; 39, Suigen; 40, Urutin; 41, Huzan; 42, Kôsyû; 43, Nagasaki; 44, Lake Tibesan.

of thoracic legs very similar in configuration. Third leg reaches to frontal margin of antennal scale, a little longer than first one, proportions to dactylus: propodus 2.4, carpus 1.1, merus 3.0; dactylus simple, slightly recurved posteriorly at tip, posterior margin of propodus armed with several equidistant setae, merus about 9 times as long as wide (Fig. 26, *A*). Fourth leg somewhat longer than third leg; ratios against dactylus: propodus 3, carpus 1.5, merus 2.9, ischium 1.1. Fifth one the longest of last three legs and reaches beyond distal margin of antennal scale by nearly half of its dactylus, proportions to dactylus: propodus 3.4, carpus ca. 2, merus 3, ischium 1.1 (Fig. 26, *N*).

Male: Very similar to female in general configuration, but endopodite of second abdominal appendage provided with rather thick, bar-shaped stylamblys and rather slender appendix masculina which is twice as long as stylamblys, fringed with rather thickly set setae along inner margin.

The above mentioned description is based on a female, 45.5 mm long and a male 32.5 mm long without rostrum. Other 191 males and 338 females, ranging from 6.5 to 17.4 mm in carapace-length, were collected from various localities of Japan proper, Hokkaidô and Korea (Fig. 3).

Locality: Lakes Abasiri and Mokoto, Hokkaidô; Titose, Goryôkaku and Sapporo, Hokkaidô; Ôhata, and Nobezi, Aomori Pref.; Lake Towada, Akita Pref.; River Mogami and Yamagata, Yamagata Pref.; River Miomote (Murakami), Niigata Pref.; Lake Kasumigaura, Ibaraki Pref.; Teganuma, Tiba Pref.; Satte, Saitama Pref.; Yamaguti, Tokyo; Yosida and Lake Hamana, Siduoka Pref.; Gihu; Kawagoye, Miye Pref.; Lake Biwa, Siga Pref.; Tokusima; Hukuyama, Hirosima Pref.; Oki Isls. (Dôgo), Simane Pref.; Hukuoka; Nagasaki; Kumamoto; Itiki, Kagosima Pref.; Suigen, Urutin and Kôshyû, Korea.

Distribution: Japan (de Haan, 1850); Simoda (Stimpson, 1860); Fusan and Gensan, Korea (Rathbun, 1902); Nemuro, Hokkaidô; Iterup, Kurile Isls. (Doflein, 1902); Hakone (de Man, 1907); Lake Biwa; Oguraike, Kyôto; River Yodo; Kasumiga-ura; Sapporo (Kemp, 1918); Komaba, Tôkyo (Yokoya, 1932); Genkagawa, Okinawa-zima, Riu Kiu (Miyadi, 1937); Etorohu-sima and Hurukamappu-numa, Kunasiri-sima (Miyadi, 1938).

Note: The specimens examined by the present author agree well with the descriptions of previous investigators, such as de Haan (1850), Stimpson (1860), Ortmann (1891), Rathbun (1902) and de Man (1907).

Three types may be recognized in the rostrum of this species: long, intermediate, and short (Fig. 4). The first is long and more or less curved upwards toward its apex; the second is moderate in length with almost straight upper border and convex lower border; and the third is short and

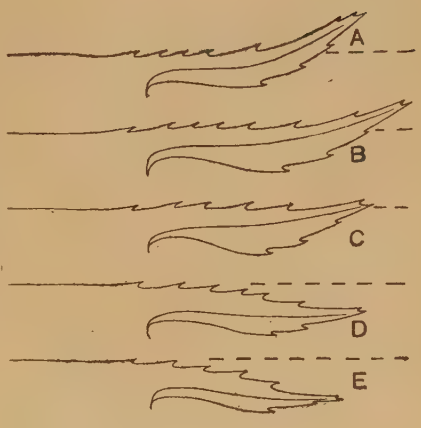

Fig. 4. Three types, 1st-type (A and B), 2nd-type (C) and 3rd-type (D and E) of rostrum of *L. paucidens*. A, figured from ♀, 50.5 mm in body-length, secured from Lake Abasiri, Hokkaidô, ×ca. 23; B, ♀, 43.0 mm long, from Lake Abasiri, ×3; C, ♀, 51.3 mm from Lake Abasiri, ×ca. 23; D, ♀, 36.0 mm, from Hukuyama, Hiroshima Prefecture, ×3; E, ♀, 34.0 mm, from the same locality as in D, ×3.

Table 4.

Locality*	Type of rostrum								
	Frequency								
	1			2			3		
	♂	♀	Total	♂	♀	Total	♂	♀	Total
Lake Abasiri	58	36	94	18	16	34			0
Lake Mokoto	5	20	25	4	20	24			0
Titose, Hokkaidô		4	4		22	22	1	14	15
Goryôkaku, Hokkaidô	1	2	3		6	6	5	10	15
Oirase River, Aomori Pref.			0	3	3	6		9	9
Lake Towada		1	1		18	18		29	29
Kajôbori, Yamagata Pref.			0	5	8	13			0
Miomote River, Niigata Pref.	2		2	3	3	6			0
Yamaguti, Tokyo			0	8	7	15	6	5	11
Lake Yamanaka		21	21		6	6			0
Kogata-Mura, Nagano Pref.			0		9	9		2	2
Momotori, Mie Pref.			0	3	3	6	10	7	17
Hukuyama, Hirosima Pref.			0			0	51	49	100
Urutin, Korea			0		3	3			0
Kôsyû, Korea			0		3	3			0
Suigen, Korea	2	2	4	3	3	6			0
Total in number	68	86	154	50	127	177	73	125	198

* Localities, roughly arranged according to the latitude from North to South.

somewhat descending. The first and second types are mostly found in specimens from places of higher latitudes, viz., Lakes Mokoto and Abasiri (Hokkaidô) and of greater altitudes such as Lake Yamanaka, Yamanasi Prefecture (Fig. 5).

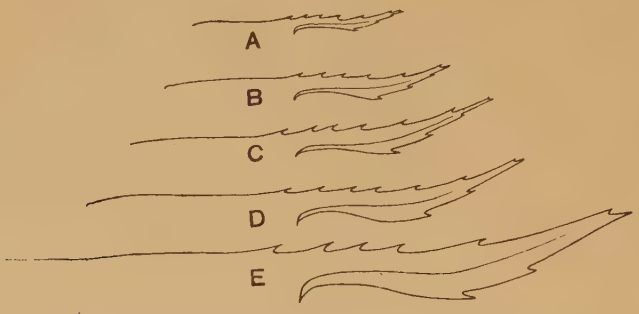

Fig. 5. Rostrums of various stages of *L. paucidens* obtained from Lake Abasiri (magnification 3). A, ♀, 4.2 mm in carapace-length; B, ♀, 5.5 mm; C, ♂, 6.8 mm; D, ♀, 8.0 mm; E, ♀, 13.0 mm.

But the second stands intermediate in distribution between the first and the third which is mainly found in the waters of lower latitudes, viz., Main Islands of Japan (Table 4).

The range of variation of rostral spines is from 4 to 8 in upper and from 1 to 4 in lower, mostly 6 in the former and 2 in the latter. The

Table 5.

Frequency table of rostral spines of *L. paucidens*.

Locality	Sex	Number of rostral spines								
		upper					lower			
		4	5	6	7	8	1	2	3	4
Lake Abasiri, Hokkaidô	♀		6	28	22	1	1	33	23	
Titose, Hokkaidô	♀		9	15	1		3	14	8	1
Lake Towada, Akita Pref.	♀	1	8	35	6		2	30	18	
Momotori, Mie Pref.	♀		1	18	14	1	3	16	13	2
Hukuyama, Hirosima Pref.	♀	2	14	26	8		13	36	1	
„ „	♂	1	18	22	8		22	26		
Total		4	56	144	59	2	44	155	63	3
%		1.5	21.1	54.3	22.3	0.8	16.6	58.5	23.8	1.1

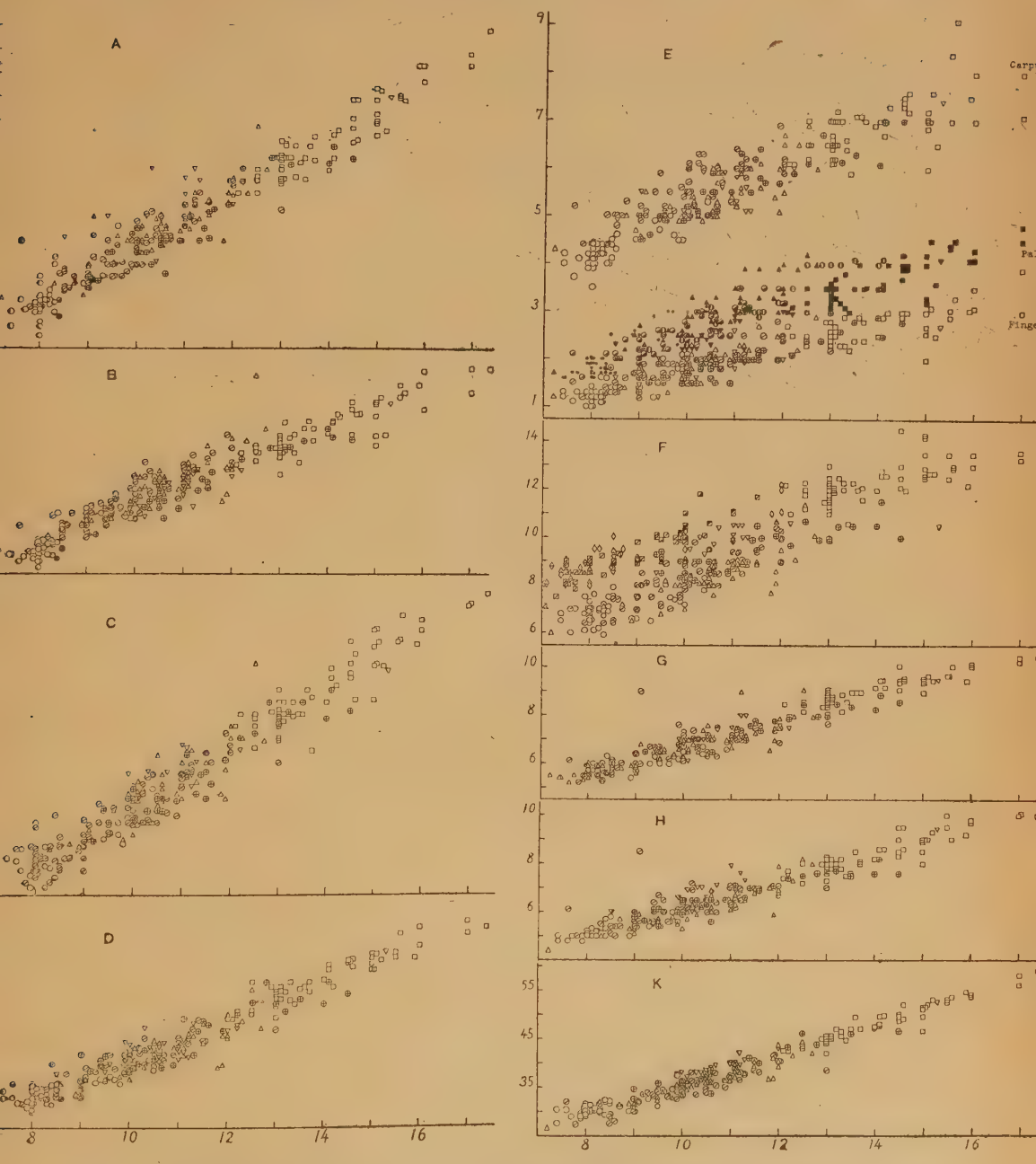

Fig. 6. Showing dimensions (in mm) of the first (*A*), second (*B*), third (*C*), fifth (*D*) legs, carpus, palm and finger of the second pereiopod (*E*), rostrum (*F*), antennale scale (*G*), telson (*H*) and body-length (*K*) in relation to the carapace-length. ∅, ♀, from Lake Towada; ▽, ♀, from Titose, Hokkaidô; ○, ♂, from Hukuyama, Hirosima Prefecture; △, ♀, from Hukuyama; ⊕ and ◐, ♀, from Momotori, Mie Prefecture; ◪, ♂, and □, ♀, from Lake Abasiri, Hokkaidô; ◇, ♂ and ◇, ♀, from Lake Mokoto, Hokkaidô; ▲, ♂ and ▲, ♀ from Miomote River; ◪, ♂ and ◩, ♀, from Suigen, Korea.

frequency distribution of the rostral spines is given in Table 5 which shows no definite relation with sex and locality.

Fig. 6 (A~K) illustrates relative length of various bodily parts against the carapace, but shows no local variation whatever in those of first, second, third and fifth pereiopods, finger, palm and carpus of second cheliped, outer margin of antennal scale and telson.

In regard to relative growth against carapace, however, the first limbs stands at variance with others. It is nearly isogonic both in younger and older specimens. Negative a heterogony is evident in telson and antennal scale in all material. But heterogony occurs negatively in older (about 13 mm in carapace-length and about 43 mm in total length) but in younger, the rostrum, second leg and the movable finger, palm and carpus of the same pereiopod are positively heterogonic. (Fig. 6).

Ten ova in alcohol, removed from 41.0 mm long specimen secured from Nagano Prefecture, measure 1.11~1.25 mm long, 1.19 mm on average and 0.87~1.04 mm broad, 0.93 mm on average. The dimensions obtained by the writer are considerably smaller than those of de Man (1907, p. 407), Yokoya (1931, p. 107) and Matui and Wainai (1937, pp. 40–41) as shown in the Table 6.

Table 6.

Egg-size in mm of *L. paucidens*.

No.	Body-length, (mm)	Range of egg-size	Average of egg-size	Number of eggs examined	Investigator	Locality where mother shrimps collected
2	54~55	1.8~2×1.4~1.5	—	—	de Man	Hakone, Kanagawa Pref.
—	—	1.75×1.28	—	—	Yokoya	Komaba, Tokyo.
7	53.8~59.4	1.36~1.64×1.01~1.20	—	20	Matsui	Lake Towada, Akita Pref.
1	41.0	1.11~1.25×0.87~1.04	1.19×0.93	10	Kubo	Nagano Pref.

No., number of specimens examined.

Colour in life: The carapace is traversed by two blackish brown narrow cross-bands and one, on each side, longitudinal stripe arising from about infra-orbital angle of carapace. The abdomen is provided with almost invariably seven blackish brown narrow cross-bands in such a way that two are situated on the first pleonic somite and one on each somite from the second to the sixth (Fig. 29, Lower).

This species is the most widely distributed in Japanese fresh waters and sometimes brakish waters from southern parts of Kurile Islands to

Kyûshû and Korea. But no specimen has been obtained from Formosa as yet.

Leander serrifer Stimpson

Leander serrifer, Stimpson, 1860, p. 41; Ortmann, 1891, p. 525, Taf. 37, fig. 7; de Man, 1881, p. 139; Doflein, 1902, p. 640; Balss, 1914, p. 57; Kemp, 1925, pp. 305—306; Urita, 1926, p. 428; Yu, 1930, pp. 567—570; Yokoya, 1930, p. 543.
Palaemon serrifer, Rathbun, 1902, p. 52.
non: *Leander serrifer*, Yoshida, 1941, p. 26, pl. 6, fig. 3.

Rostrum rather broad, with lateral ridge, horizontally straight, not reaching to distal margin of antennal scale but more or less beyond terminal margin of antennular peduncle, about 1.1 times as long as carapace, upper border horizontal, furnished with equidistant 10 teeth, of which one is subapical and posterior three are placed in one-third of carapace; lower border convex, armed with four teeth (Fig. 30, upper). Infra-orbital and branchiostegal spines well developed. Pterygostomian angles rounded. All abdominal terga dorsally rounded. Sixth pleonic segment ca. 1.4 times as long as fifth but somewhat less than half of carapace. Telson belongs to *paucidens*-group, about three times as long as wide, when measured between antero-lateral angles; the widest proximal breadth a little more than twice the distance between postero-lateral angles; each dorso-lateral margin provided with one anterior seta at about three-fifths and one posterior at about three-fourths (Fig. 29, *C*). Eye moderate, about one and half times as long as wide; cornea slightly broader than stalk, both inner and outer corneal lobes developed, the outer much larger than the other (Fig. 24, *C*). Antennal peduncle three-segmented; basal segment broad, depressed with stout basal lateral spine reaching the middle of the segment, distal outer angle ending in a prominent spine which extends to about middle of second segment; second segment about half times as long as first segment and slightly less than half of first one (measured along median line), about 1.9 times as long as wide; third segment equals to second in length and breadth, provided with inner thinner flagellum which is about 1.5 times as long as carapace, and with outer thicker flagellum which is about 2.5 times as long as carapace, and proximally uniramous with about eight joints but distally bifid with shorter inner branch and about five times longer outer one (Fig. 24, *N*). Antennal scale rather broad, somewhat narrowed anteriorly with straight outer margin ending in an acute spine which does not reach as far forwards as the rather broadly rounded distal margin of lamella; about 3.4 times as long as wide measured at middle (Fig. 23, *J*). Antennal flagella about six times as long as carapace. Maxillula cross-

shaped, inner endite and endopodite subequal in size, apical lobe of the latter rather large, outer endite a little thicker than each inner and outer lacinia, fringed with thickly set setae along distal margin (Fig. 19, *N*). Third maxilliped reaches somewhat beyond distal margin of basal segment of antennular peduncle; basal segment about seven times as long as wide; penult segment about five and half times as long as wide and ca. 0.7 times as long as basal one; last one a little shorter than half of basal segment (Fig. 23, *C*). First thoracic leg extends beyond antennal scale by about one half of chela, proportions against movable finger: palm 1, carpus and merus ca. 3, both fingers of chela armed with no tooth on each prehensile edge; merus about eight times as long as wide. Second leg stout, the longest of all legs, extends beyond antennal scale by chela, ratios against movable finger: palm 1.5, carpus 1.6, merus 1.7, both fingers of chela with acute inturned tips, movable finger carries two small teeth on proximal one-fourth of cutting edge, fixed finger armed with a tooth at one-sixth of prehensile edge; palm subcircular in cross-section, about 3.1 times as long as wide, carpus about five times as olng as broad, merus about five and half times as long as wide (Fig. 25, *C*). Last three pereiopods similar in general aspect. Third pereiopod reaches beyond antennal scale nearly by dactylus; dactylus simple, slightly curved backwards about three times as long as dactylus, posterior margin provided with several equidistant setae; carpus about 1.7 times as long as propodus; merus as long as propodus, about seven times as long as wide (Fig. 26, *C*). Fourth pereiopods nearly reach to distal margin of antennal scale, ratios to dactylus: propodus 4.5, carpus 2, merus 4.4. Fifth one slenderer than fourth leg but does not extend beyond the scale; proportions against dactylus: propodus 3.5, carpus 2.1, merus 3.6; distal one-fifth of posterior border of propodus furnished with rather thickly set setae; merus about 9 times as long as wide (Fig. 26, *P*). Endopodite of second pleopod provided with bar-shaped stylamblys on inner margin (Fig. 28, *K*).

Male: Similar to female in general appearance, but endopodite of second abdominal appendage bears an appendix masculina and a slender appendix interna on inner margin, the former distally fringed with long setae, somewhat shorter than the latter (Fig. 28, *B* and *K*).

Egg subglobular, rather small, dimension ranges from 0.96~1.06 mm, 1.01 mm on average in longer diameter, but from 0.76~0.92 mm, 0.82 on average in shorter one, as measured in those removed from a specimen, 31.0mm long.

The description mentioned above is based on a female, 27.0 mm in body-length and a male, 22.5 mm long. Six male specimens ranging 19.5~23.5

mm long and 25 females, from 15.5 to 35.8 mm long were also examined.

Locality: Kominato, Tiba Prefecture.

Distribution: Hong Kong; Ousima (Stimpson, 1860); Yokohama; Amoy (de Man, 1881); Tsingtao (Doflein, 1902 and Urita, 1926); Misaki and Atami, Kanagawa Prefecture (Rathbun, 1902); Kominato, Tiba Pref.; Sagami Bay; Nagasaki; Tokyo (Balss, 1914); Yangmatoa (Yu, 1930).

Note: The rostrum is quite straight in most specimens, but sometimes slightly recurved upwards toward apex as already pointed out by de Man (1881, p. 140) and Kemp (1925, p. 305).

The upper rostral spines vary from 9 to 13 in number. Of 33 specimens, 16 have 11 (48.4%), 10 have 10 (30.3%), 4 have 12, 2 have 9 and only 1 has 13 teeth. The lower border provided with 3 or 4 teeth, but mostly with three teeth as shown in Table 7.

Table 7.

Frequency of rostral spines of *L. serrifer*.

Items		Number of upper rostral spine					Total
		9	10	11	12	13	
Frequency	♂		1	6			7
	♀	2	9	10	4	1	26
	Total	2	10	16	4	1	33

Items		Number of lower rostral spine		Total
		3	4	
Frequency	♂	3	4	7
	♀	21	5	26
	Total	24	9	33

Sexual difference is hardly seen in relative growth (Fig. 8) of all thoracic legs and finger, palm, carpus and merus of second cheliped and propodus and dactylus of third leg and rostrum as referred against carapace-length. But remarkable sexual dimorphism is evident in the first and second pleonic appendages as already mentioned above.

The present species is nearly related to *Leander paucidens* (de Haan), but it is easily distinguished from the latter by a number of the characters shown in the following table.

Besides, these two species differ in habitat, viz., *L. paucidens* (de Haan) is found commonly in fresh water and sometimes in brackish water, but *L. serrifer* Stimpson is essentially a salt water species but never a fresh-water inhabitant.

Table 8.

Items	*L. paucidens*	*L. serrifer*
1. Shape of rostrum	Somewhat descending or slightly recurved upwards in subterminal portion	Almost horizontally straight
2. Number of upper rostral spines	Ranges 4~8, mostly 6	Ranges 9~13, mostly 10 or 11
3. Number of lower rostral spines	Varies 1~4, mostly 2	3 or 4, mostly 3
4. Antennal scale	Broad	Rather broad
5. Movable finger of second leg	Armed with 1 tooth	Armed with 2 teeth
6. Appendix masculina	Large and thick, fringed with rather thickly set short setae	Slender, fringed with sparsely set long setae
7. Egg	Large, 1.11 × 0.93 mm on average	Rather large, 1.01 × 0.82 mm on average

YOSHIDA (1941) referred a shrimp from Korea to the present species. But it decidedly differs from the species in question since its rostrum, according to his figure and description, is recurved toward apex, extending considerably beyond antennal scale.

Leander macrodactylus (RATHBUN)

Palaemon macrodactylus, RATHBUN, 1902, pp. 52~53, fig. 24(a~d); BALSS, 1924, p. 50.

Leander macrodactylus, PARISI, 1919, p. 76.

Leander serrifer longidactylus, YU, 1930, pp. 570~573, fig. 4 (B′ and C′).

non: *Leander macrodactylus*, YOSHIDA, 1941, pp. 26~27, pl. 6, fig. 4.

Shell smooth. Rostrum rather deep, provided with low lateral carina, almost horizontally straight but slightly recurved upwards in subterminal portion, about as long as carapace; upper border armed with 11 teeth, posterior three of them placed on one-third of carapace, interval between the hindmost spine and penult one and that between second and third spines somewhat larger than that between any other two spines; lower border convex, with four spines (Fig. 30, Middle). Infra-orbital and branchiostegal spines conspicuous. Abdomen without dorsal median carina, sixth pleonic segment a little (1.2 times) more than fifth one and somewhat less than half of carapace in length. Telson belongs to *paucidens*-group, shorter than uropods but over 1.4 times as long as sixth pleonic somite; each dorso-lateral margin armed with two setae, proximal one situated at about middle and the other one at about three-fourths; distal margin provided with two pairs of outer shorter and inner longer (about four times as long as outer one) bristles (Fig. 29, *D*). Eye well pigmented, about 1.4 times as long as broad;

cornea slightly wider than stalk, occupies about distal half of eye, both inner and outer corneal lobes well developed especially in the latter (Fig. 24, *D*). Antennular peduncle closely resembles that of *L. serrifer* Stimpson, basal segment subrectangular in outline, about twice as long as wide, provided with a large lateral spine on basal outer margin, reaching to about its middle, distal outer angle with an acute spine which reaches to about middle of second segment; second joint about 1.6 times as long as wide about half as long as but a ilttle more than half as wide as first segment; third segment as long as and as broad as second one, provided with inner thinner and outer thicker rami, the inner one about twice as long as carapace, the outer one nearly twice as long as inner one, proximally uniramous with about seven joints but distally divided into inner shorter comprising 26 segments and outer longer branches (Fig. 24, *O*). Antennal scale rather narrow, slightly narrowed anteriorly, about 3.3 times as long as broad; outer margin nearly straight, ends in a stout spine which does not extend beyond distal margin of lamella (Fig. 23, *K*). Antenna much longer than antennule, about six times as long as carapace. Maxillule closely related to that of *L. serrifer* Stimpson, but apical lobe of endopodite much larger than that of *L. serrifer* (Fig. 19, *O*). Third maxilliped reaches to about middle of antennal scale, proportions against last segment: antepenult 1.6, penult 1.1; basal segment remarkably curved with concave border towards median line, terminally dilated; penult segment somewhat thinner than basal one, about six times as long as broad; last segment pointed, fringed with rather thickly set setae (Fig. 23, *D*). First pereiopod slender, slightly extends beyond tip of antennal scale, ratios against movable finger: palm 1.1, carpus 4, merus 3.5; both fingers with straight prehensile edges which are armed with no tooth; merus about 9 times as long as wide. Second pereiopod the largest, reaches beyond antennal scale by entire chela and distal one-third of its carpus; proportions to movable finger: palm 1.2 (Fig. 7), carpus, merus and

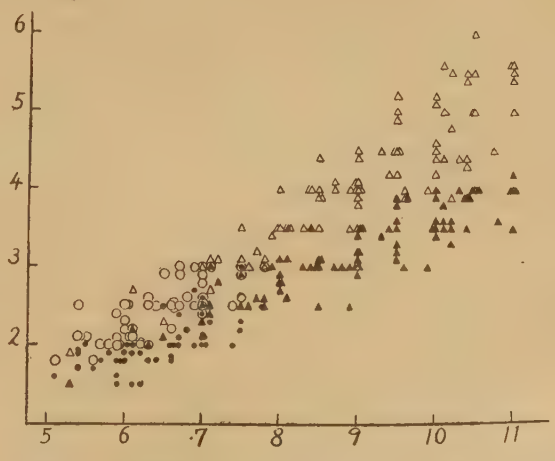

Fig. 7.- Dimension (in mm) of palm (soft marks) and finger (solid marks) of second pereiopod of *L. macrodactylus* in relation to carapace-length. Circles, male; triangles, female.

ischium about 1.8; fingers with pointed inturned tips, cutting edges nearly straight but armed with two teeth near base of movable finger and one tooth on fixed finger opposite the distal tooth of movable finger; palm oval in cross-section, about 3.5 times as long as wide; carpus gradually distally dilated; merus about ten times as long as broad (Fig. 25, *D* and *D'*). Last three pereiopods much alike with each other in configuration. Third leg extends beyond antennal scale by half of dactylus, longer than first leg, proportions against dactylus: propodus ca. 2, carpus ca. 1, merus 2.2; dactylus simple, slender, about as long as carpus, more or less recurved backwards; propodus armed with several equidistant setae along its posterior margin, merus about 13 times as long as wide (Fig. 26, *D*). Fourth leg a little longer than third one. Fifth leg the longest of all ambulatory ones, reaches beyond distal margin of antennal scale by almost entire dactylus, proportions to dactylus: propodus 2.3, carpus 1.5, merus 2.8 (Fig. 26, *Q*). Endopodite of second abdominal appendage quite similar to that of *Leander serrifer* STIMPSON in both sexes respectively, but appendix masculina slightly longer than stylamblys (Fig. 28, *C* and *L*).

Egg small, ranging from 0.53 to 0.63 mm in larger diameter, 0.58 mm on average and varying from 0.41 to 0.48 mm in the other diameter, 0.44 mm on average.

The above mentioned description is based on a male measuring 27.5 mm in body-length and an ovigerous female, 32.5 mm long. A number of specimens from Ômori, Tokyo Bay obtained on May 17th, 1938, including 50 males ranging 5.1~7.8 mm in carapace-length (21.4~30.2 mm long) and 86 females (mostly ovigerous) 5.3~11.0 mm in carapace-length (18.8~38.2 mm long) were also examined.

Locality: Tokyo Bay; Atumi Bay (Nisiura-mura, Aiti Pref.); Hatirô-gata.

Distribution: Aomori; Matsushima; Nagasaki; Fusan; Gensan; Chemulpo (RATHBUN, 1902); Sagami Bay (PARISI, 1919); Yangmatoa; Peitaiho; Tangkou; Chefoo (YU, 1930).

Note: The specimens dealt with here show little variation in the shape of rostrum. However, both the upper and lower rostral spines are rather variable in number; they range from 10~13 in each sex on upper border and 3 or 4 in male, 3~5 in female on lower border (Tables 9 and 10).

Sexual dimorphism of this species is observed in endopodites of first and second abdominal appendages, especially in that of the second one; it is so distinct that sex recognition of this shrimp is easy in this respect even in such small specimens about 10 mm long without rostrum.

It is worth mentioning that the relative growth of the first leg reaches

Table 9.

Correlation between carapace-length and number of upper rostral spines of *L. macrodactylus*.

Items		Number of upper rostral spines							
		♂				♀			
		10	11	12	13	10	11	12	13
Length of carapace (mm)	5~6		6	4	2			1	
	6~7	6	10	6	2		3		
	7~8	1	7	5	1	1	10	2	
	8~9					6	8	4	1
	9~10					2	14	5	2
	10~11					3	11	5	3
	11~12						3	2	
Total		7	23	15	5	12	49	19	6
%		14.0	46.0	30.0	10.0	14.0	57.0	22.1	6.9

Table 10.

Correlation between carapace-length and number of lower rostral spines of *L. macrodactylus*.

Items		Number of lower rostral spines				
		♂		♀		
		3	4	3	4	5
Length of carapace (mm)	5~6	3	9		1	
	6~7	11	13	1	2	
	7~8	3	11	8	4	1
	8~9			9	9	1
	9~10			8	15	
	10~11			2	19	1
	11~12			2	2	1
Total		17	33	30	52	4
%		34.0	66.0	34.9	60.5	4.6

its maximum at about 10 mm in carapace-length (36 mm in body-length) (Fig. 8, *F*).

The specimens examined mostly agree with the description and figures of Rathbun's *Palaemon macrodactylus* (=*Leander macrodactylus*), but show some descrepancies in proportional characters as shown in the following table.

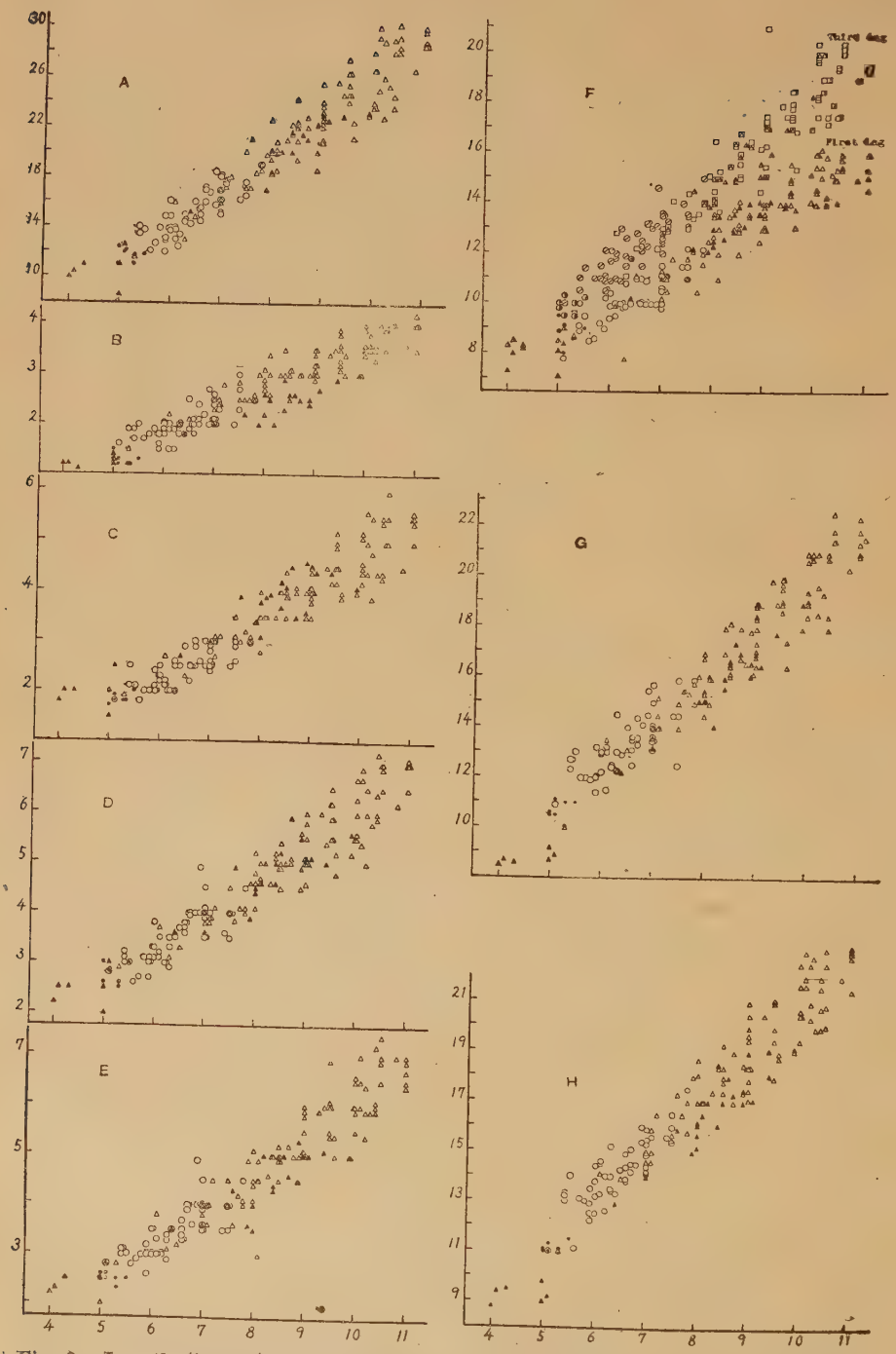

Fig. 8. Length (in mm) of second leg (A) and finger (B), palm (C), carpus (D) and merus (E) of second pereiopod, first, third (F), fourth (G) and fifth (H) pereiopods in relation to carapace-length (in mm). ● and ◑, ♂ and ▲ and ◭, ♀ of *L. serrifer*; ○ and ⊘, ♂ and △ and □, ♀ of *L. macrodactylus*.

Table 11.

Items	*L. macrodactylus* Rathbun	Present specimens
1. First leg	Carpus one and two-thirds times as long as chela.	Carpus about 2 times as long as chela.
2. Second leg	Palm a little longer than finger, carpus subequal to merus, palm longer than fingers.	Carpus, merus and ischium about 1.8 times as long as dactylus; palm 1.2 times as long as finger.
3. Third leg	Dactyli are contained twice or two and a half times in their propodi.	Propodus ca. 2 times as long as finger.
4. Fifth leg	Dactyli are contained about three times in their propodi.	Propodus 2.3 times as long as dactylus.
5. Sixth pleonic segment	Half as long as the carapace, and three-fourths as long as the telson.	Half of carapace and about five-sevenths times as long as telson.

Again, the specimens at the author's disposal tally closely in principal characters with the description and the illustrations of Yu's *Leander serrifer longidactylus*. Thus, *L. serrifer longidactylus* Yu is probably synonymous with *L. macrodactylus* (Rathbun).

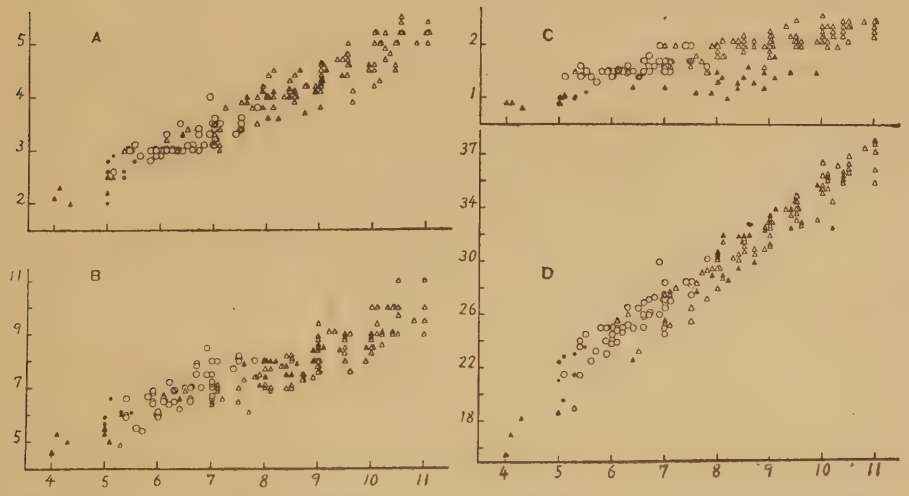

Fig. 9. Relative growth of propodus of third pereiopod (A), rostrum (B), dactylus of third thoracic leg (C) and body-length (D) against carapace-length. Solid marks, *L. serrifer;* soft marks, *L. macrodactylus;* circles, male; triangles, female. (Dimensions, in mm).

The present species, so far defined, may be separated from *L. serrifer* by much longer dactyli of last three pairs of pereiopods (Fig. 9, *C*) and also by the characters tabulated in Table 12.

Table 12.

Items	*L. macrodactylus*	*L. serrifer*
1. Eye	rather thick	rather slender
2. Relative length of movable finger of second leg against carapace-length	rather large	rather small
3. Relative length of fifth leg against carapace-length	rather large	rather small
4. Size of egg (mm)	0.53～0.63 × 0.41～0.48 in diameters	0.96～1.06 × 0.76～0.92 in diameters

Leander pacificus STIMPSON

Leander pacificus, STIMPSON, 1860, p. 40; DE MAN, 1881, p. 137; ORTMANN, 1891, p. 519; DOFLEIN, 1902, pp. 639～640; BALSS, 1914, p. 57; KEMP, 1925, pp. 307～308; YU, 1930, p. 555.
Palaemon pacificus, RATHBUN, 1902, p. 53; 1906, p. 924, Pl. 22, fig. 3.

Rostrum moderately deep, with lateral carina, subhorizontal in proximal about half but upturned toward its extremity stretches a little beyond tip of antennal scale, about as long as or somewhat longer than carapace; dorsal carina extends backwards to about middle of carapace, armed with many teeth which are arranged in two groups, 8 proximal (3 or 2 placed on carapace) teeth being separated by a wide interval (usually about one-third of rostrum) from one or two subterminal teeth; ventral border convex, provided with 3～5 teeth. Suborbital and branchial spines prominent. Abdomen dorsally rounded. Sixth pleonic segment about half as long as carapace. Telson belongs to *paucidens*-group; shorter than uropods but a little longer than sixth abdominal segment, ca. 3 times as long as distal wide between posterolateral angles, each dorso-lateral margin provided with two bristles, proximal one situated near middle and the other one at about one-fourth; terminal margin angulated and pointed at middle, furnished with two pairs of outer minor and inner major (about five times as long as minor one) setae (Fig. 29, *B*). Eye closely resembles that of *Leander macrodactylus*, about one and half times as long as wide; cornea slightly wider than stalk and occupies about half of eye (Fig. 24, *B*). Antennular peduncle does not reach to extremity of antennal scale; basal segment depressed, subrectangular in upper aspect, about half as broad as long, with prominent spine on basal outer margin, which reaches to about its middle, distal outer angle armed with one stout spine; second segment about 1.1 times as long as wide, about 0.6 times as broad as basal segment; third segment slightly longer and slenderer than second one, carries inner thinner and outer thicker flagella, inner one about two and half times as long as

long. A lot of specimens consisting of 114 males ranging 12.0~42.3 mm long and 212 females, 13.0~49.0 mm in body-length, were also examined. All specimens were obtained from Kominato, Tiba Prefecture.

Locality: Kominato, Tiba Pref.; Ôsima, Izu; Miya, Aiti Pref.; Itiki, Kagosima Pref.; Simoda, Siduoka Pref.; Nobeoka, Miyazaki Pref.

Distribution: Hong Kong; Hawaii; Simoda (STIMPSON, 1860); Amboina (DE MAN, 1881); Sagami Bay (DOFLEIN, 1902 and BALSS, 1914); Misaki; Wakanoura, Wakayama Pref.; Nagasaki (RATHBUN, 1902); Hawaii (RATHBUN, 1906).

Note: Remarkably enough, STEBBING's (1917, p. 34, Pl. 93, B) specimens differ from mine in having two occular spots in stead of a single ocellus.

As regards the shape and proportions of the rostrum as well as number

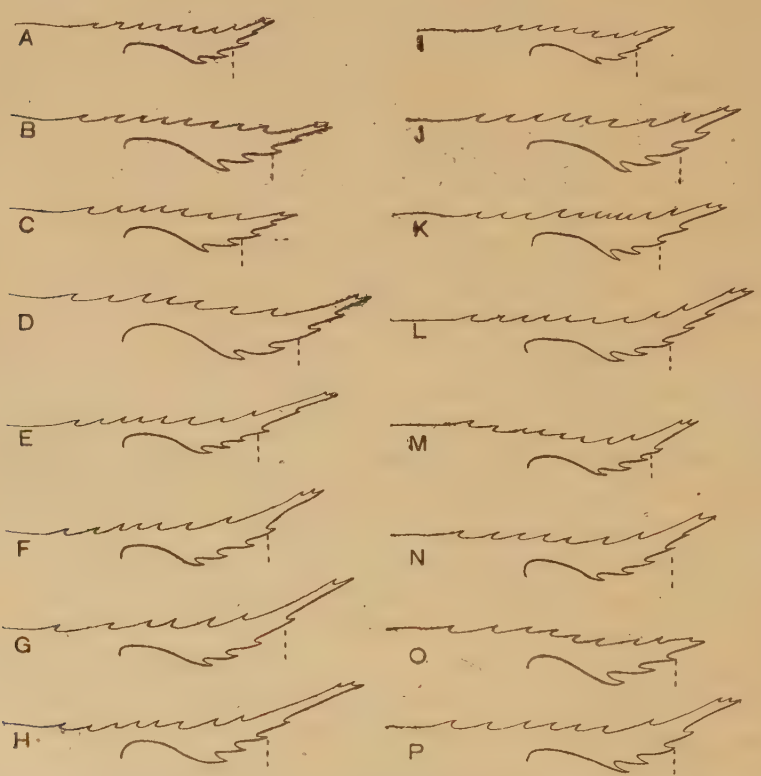

Fig. 10. Showing variation of rostrum of males (A~H) and females (I~P) of *L. pacificus;* broken lines indicating the extremity of antennular peduncle. A, 12.0 mm in body-length, ×6; B, 15.5 mm, ×6; C, 16.0 mm, ×6; D, 19.0 mm, ×6; E, 30.0 mm, ×2.5; F, 33.0 mm, ×2.5; G, 35.8 mm, ×2.5; H, 39.0 mm, ×2.5; I, 12.5 mm, ×6; J, 17.4 mm, ×6; K, 24.9 mm, ×3; L, 26.8 mm, ×3; M, 38.5 mm, ×2; N, 44.0 mm, ×2; O, 47.0 mm, ×2; P, 46.0 mm, ×2 (All specimens secured from Kominato, Tiba Prefecture).

Table 13.

Correlation between carapace-length and number of upper rostral spines of *L. pacificus*.

Items		Number of upper basal rostral spines									
		♂				♀					
		6	7	8	9	6	7	8	9	10	11
Length of carapace (mm)	2～4		3	2	1		3	3			
	4～6		31	18			23	21	3		
	6～8	1	21	23			40	42	2		1
	8～10	1	4	7	1	1	14	15	1		
	10～12			1			8	18	1		
	12～14						7	9			
Total		2	59	51	2	1	95	108	7	0	1
%		1.8	51.8	44.7	1.8	0.5	44.8	50.9	3.3	0	0.5

Table 14.

Correlation between carapace-length and number of spines on apex of rostrum of *L. pacificus*.

Items		Number of spines on apex of rostrum			
		♂		♀	
		2	3	2	3
Length of carapace (mm)	2～4	6		6	
	4～6	30	19	29	18
	6～8	20	25	37	48
	8～10	7	6	16	19
	10～12		1	12	11
	12～14			8	8
Total		63	51	108	104
%		55.3	44.7	50.9	49.1

of both rostral spines, it is shown in Table 13～15 and Fig. 10, that the upper rostral spines ranges from 6 to 9 in male and from 6 to 11 in female, but usually 7 or 8 in both sexes excluding accessory subterminal spines, whereas the lower rostral spines range from 3 to 6 in male and from 2 to 6 in female, but the modal number is 4 in both sexes. No correlation exists between the number of rostral spines and rostral length in both sexes. The tip of rostrum was described by STIMPSON and others to be trifid with two

Table 15.

Correlation between carapace-length and number of lower rostral spines of *L. pacificus*.

Items		Number of lower rostral spines								
		♂				♀				
		3	4	5	6	2	3	4	5	6
Length of carapace (mm)	2~4	1	5					6		
	4~6	2	42	3			2	42	3	
	6~8	2	35	10			2	70	13	
	8~10		8	4	1	1		21	9	
	10~12		1					18	8	1
	12~14						1	11	4	
Total		5	91	17	1	1	5	168	37	1
%		4.4	79.8	14.9	0.9	0.5	2.4	79.2	17.5	0.5

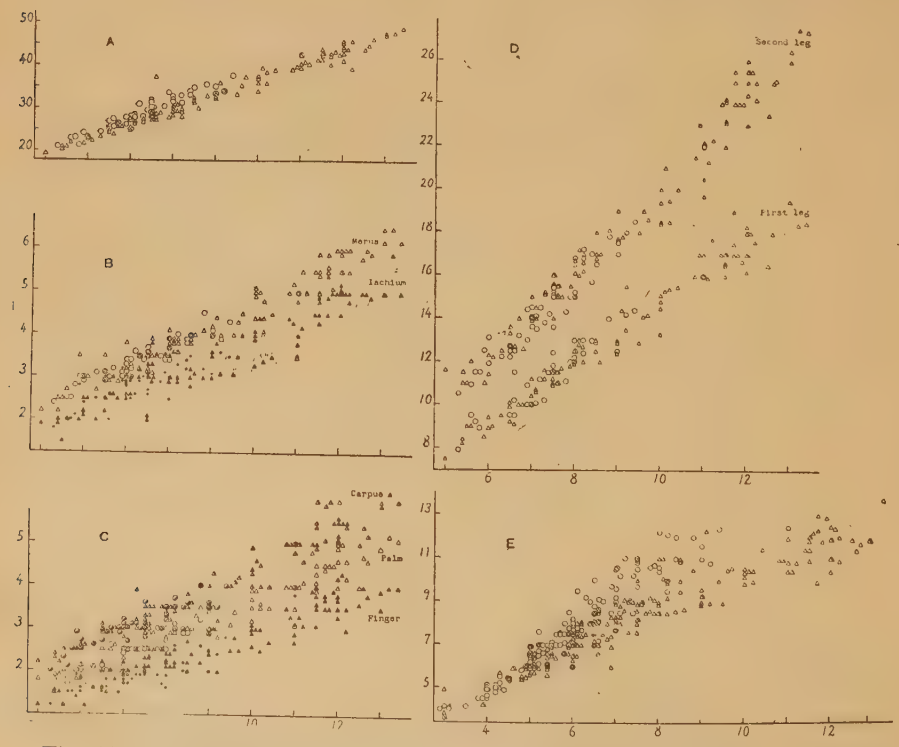

Fig. 11. Relative-growth of body-length without rostrum, ischium (A), merus (B), carpus, palm, finger (C) of second pereiopod, first and second thoracic leg (D) and rostrum (E) of *L. pacificus* against carapace-length. Dimensions, in mm; circles, ♂; triangles, ♀.

accessory subterminal spines. But my observations have revealed that the rostrum is provided with either one or two minute subterminal spines. The relative length of rostrum against carapace is distinctly larger in male than in female, even in specimens with 5.5 mm in carapace-length (ca. 21 mm in body-length) as graphically illustrated in Fig. 11, *E*.

But relative lengths, as referred to carapace, of the first and second chelipeds, the ischiopodite, meropodite, carpopodite, palm and movable finger of the second cheliped do not differ so clearly in both sexes as shown in the accompanying figures (Fig. 11, *A*~*C*). The stylamblys of the endopodite of the second abdominal appendage is slender in both sexes. Although similar in shape irrespective of age (Fig. 12, *A'*~*E'*), the stylamblys of female assumes sparsely hairy appearance along its inner border when the specimens grow over 40 mm in body-length (Fig. 12, *A'*). On the other hand, the stylumblys of male fringed with rather long setae along its outer

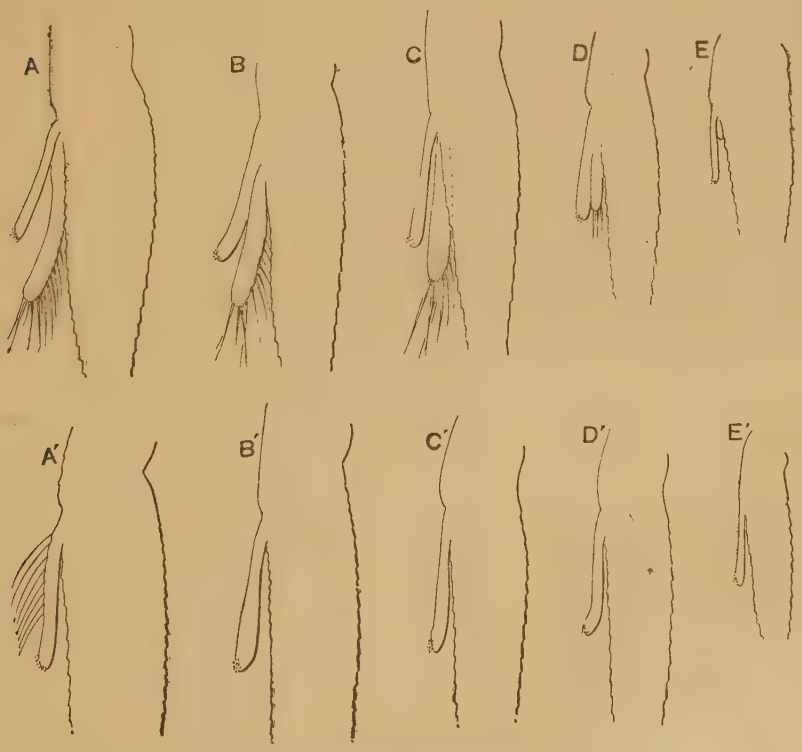

Fig. 12. Endopodite of second abdominal appendage of males (A~E) and female (A'~E') of *L. pacificus*. A, 37.0 mm in body-length, ×15; B, 27.0 mm, ×25; C, 19.5 mm, ×35; D, 15.5 mm, ×35; E, 12.0 mm, ×35; A', 41.5 mm, ×15; B', 33.0 mm, ×25; C', 22.0 mm, ×35; D', 18.5 mm, ×35; E', 13.0 mm, ×35.

and distal margins in specimens larger than 19 mm in body-length (Fig. 12, *A*~*C*). The appendix masculina is not found in specimens smaller than 12 mm in body-length; it makes its appearance in male when it attains a body-length of 15.5 mm (Fig. 12, *E*). But the appendix is not only shorter than the stylamblys but scarcer in setae which are confined to distal margin (Fig. 12, *E*).

The present species is closely related to *Leander serrifer* STIMPSON (1860, p. 40), *L. macrodactylus* (RATHBUN) (1902, p. 52, fig. 24) and *L. fagi* YU (1930, pp. 561~564, fig. 2 (*A*~*E*), but it is easyly distinguished from *L. serrifer* by having the following characters, e.g., (1) rostrum recurved upwards with trified or bifid tip and (2) colour pattern more complex; from *L. macrodactylus* by having upturned rostrum and comparatively short dactylus on all ambulatory legs; and from *L. fagi* by having longer second cheliped.

This amimal is commonly found as a shore shrimp along Pacific coast of Main Island of Japan and whole coast of Kyûshyû, and makes good bait for fishing.

Leander gravieri YU

Leander gravieri YU, 1930, pp. 564~567, fig. 3, A~C.
Leander macrodactylus, YOSHIDA, 1941, pp. 26~27, Pl. 6, fig. 4.

Body rather large, shell smooth. Rostrum rather deep, with lateral low carina, subhorizontal but somewhat recurved upwards in distal half, about as long as or somewhat longer than carapace, stretches beyond tip of antennal scale by one-fourth the length (Fig. 30, lower); dorsal carina extends backwards to about middle of carapace; upper border almost horizontally straight, armed with 12~17 teeth excluding isolated subterminal teeth, posterior three of them placed on carapace; tip bifid or trifid with one or two accessory teeth respectively; lower border armed with 5~6 teeth. Infraorbital and branchiostegal spines rather prominent. Antero-lateral angles of carapace rounded. Abdomen dorsally rounded. Sixth abdominal somit a little less than half of carapace and about one and half times as long as fifth pleonic segment. Telson shorter than uropods but somewhat longer (ca. 1.2 times) than sixth pleonic somite, about 3 times as long as wide measured in the largest proximal region and about 12 times as long as wide between postero-lateral angles; dorso-lateral margins armed with two pairs of setae, proximal one placed at about three-fifths and the other one at about four-fifths; terminal margin angulated, minutely pointed at middle, provided with two pairs of outer shorter and inner three-times longer ones (Fig. 29, *E*). Eye thick, with cornea in distal two-thirds, about as

long as wide, both inner and outer corneal lobes well developed (Fig. 24, *E*). Antennular peduncle reaches to about middle of antennal scale; basal segment depressed, subrectangular in outline, about 1.6 times as long as wide, basal outer margin armed with prominent spine reaches about its middle, distal outer angle ends in a stout spine; second segment short, about as long as wide, about one-third the length and about two-thirds the width of basal one; terminal segment about twice as long as second one, about half times as wide as long, provided with inner thinner and outer thicker rami, thinner ramus about two and half times as long as carapace, thicker one basally uniramous with about 7~8 joints, distally with inner shorter and outer longer ramus which is about 9 times as long as shorter one (Fig. 24, *P*). Antennal scale moderatetly broad, subrhombic in shape but slightly narrowed anteriorly, about three times as long as wide measured at middle; outer margin nearly straight, ends in a stout spine which is far exceeded by lamella (Fig. 23, *L*). Antennal flagellum long, about 6.5 times as long as carapace. Maxillule closely resembles that of *L. serrifer* Stimpson, but apical lobe of endopodite is somewhat smaller than that of said species (Fig. 19, *P*). Third maxilliped hardly reaches to middle of antennal scale, proportions to last segment: antepenult 1.8, penult 1.1; antepenult considerably recurved with concave margin towards median line, subterminal portion remarkably dilated; penult joint about five times as long as wide; last one pointed (Fig. 23, *E*). First chelipeds slender and shortest of all, attain tip of antennal scale, ratios against movable finger: palm 1, carpus 4, merus 3; fingers unarmed with tooth on each cutting edge; merus about ten times as long as wide. Second cheliped stoutest of all, extends beyond antennal scale by entire chela; proportions against movable finger: palm ca. 1, carpus and ischium 1.2, merus 1.4; both fingers with nearly straight prehensile edges and pointed inturned tips, movable finger usually armed with two small teeth on cutting edge close to articulation, fixed one usually carries one tooth on cutting edge close to articulation; palm suboval in cross-section, about three times as long as wide; carpus somewhat enlarged distally; merus about 13 times as long as broad. Last three pereiopods similar with each other in shape (Fig. 25, *E* and *E'*). Third leg shortest of all ambulatory, reaches beyond acicle by whole dactylopodite, proportions against dactylus: propodus ca. 1.5, carpus 0.9, merus 2.0; dactylus simple, considerably long, slightly recurved backwards; propodus armed with no seta along posterior margin, about 14.5 times as long as wide (Fig. 26, *E*). Fourth leg more or less longer than third one, ratios to dactylus: propodus 1.9, carpus 0.9, merus 2.0. Fifth one somewhat longer than fourth leg, extends beyond antennal scale by about distal one-third of propodus and

entire dactylus; propodus ca. 2.4 times as long as last segment (Fig. 26, *R*). Endopodite of second pleonic appendage carries in male slender stylamblys and appendix masculina which is slightly shorter than stylamblys and fringed with long setae on distal margin (Fig. 28, *D*), but stylamblys only in female on inner margin (Fig. 28, *M*).

Egg small, subglobular, 0.42～0.48 mm in longer diameter, 0.46 mm on average; 0.33～0.40 mm in shorter diameter, 0.37 mm on average. The material is removed from a specimen 53.4 mm long without rostrum, secured from Korea.

Colour: Body uniformly reddish in life.*

The above mentioned description is mostly based on a female, 51.5 mm long without rostrum. But four males, 34.1～40.0 mm long and five females, 38.4～57.7 mm long, were also examined. All specimens were collected from western coast of Korea by Messrs. H. YOSHIDA and T. YAMAMOTO.

Note: The upper rostral spines, exclusive of subterminal spines, range from 12～17, and the lower ones from 5 to 6 in number. Of nine specimens, three have 12, 14, 16 upper teeth respectively; two have 13; two have 15 and two have 17. On the other hand, 6 ones are provided with 6 lower

Table 16.

Measurements of bodily-parts and number of rostral spines of *L. gravieri*, from various localities.

No.	Sex	B.L.	C.L.	R.L.	Length of pereiopods 1st	2nd	3rd	4th	5th	Length of each segment of 2nd leg D	E	F	G	3rd leg F	G	Number of rostral spines upper	lower
1	♂	34.5	9.5	11.9	14.0	—	—	22.0	24.0	—	—	—	—	—	—	13+2	6
2		35.0	9.8	10.8	14.0	—	—	—	—	—	—	—	—	—	—	12+2	6
3		40.0	10.2	13.0	14.0	21.5	19.0	22.9	—	4.0	5.0	3.0	3.0	4.4	3.0	16+2	6
4		34.1	9.5	12.1	10.9	16.9	16.2	18.3	—	4.2	3.5	2.5	2.5	4.0	3.2	15+2	6
5	♀	53.5	16.6	—	20.0	—	—	—	—	—	—	—	—	—	—	—	—
6		38.4	11.0	14.0	14.3	20.0	21.1	22.4	23.8	4.5	3.7	3.0	3.2	4.9	4.0	17+2	5
7		39.5	9.9	13.8	14.5	—	—	23.1	24.6	—	—	—	—	—	—	17+2	6
8		57.7	17.7	16.7	21.8	35.8	32.0	34.0	38.5	8.8	7.5	6.0	6.0	8.1	5.0	14+1	6
9		49.0	14.5	14.5	20.2	30.5	28.5	31.2	31.2	7.0	6.4	5.1	5.3	7.3	5.3	15+2	5
10		51.5	15.0	15.6	20.0	30.3	28.5	—	—	7.2	6.5	5.0	5.1	6.5	4.9	13+1	5

B.L., body-length; C.L., carapace-length; R.L., Length of rostrum; D, merus; E, carpus; F, propodus or palm; G, dactylus.

* According to a letter imformation from Mr. H. YOSHIDA, this shrimp is, in Korea, commonly known under the name of "Aka-ebi" meaning red shrimp.

rostral teeth, and the rests with 5 ones. The tip of rostrum is mostly (7 specimens out of 9 ones) armed with 2 accessory teeth.

Table 16 gives proportional variations several body parts in reference to body-length.

The specimens at my disposal mostly tally with the original description and figures of Yu (op. cit. p. 564), but some descrepancies are observed as follows:—(1) rostrum of my specimens less recurved upwards and (2) the fingers of second chelipeds are as long as palm or slightly longer than palm (instead of somewhat shorter than palm). But it appears to me that these differences are merely fluctuations within one species.

The present species is intimately allied to *Leander macrodactylus* (Rathbun), but it is easily discriminated from the latter by having such characters, namely, (1) longer rostrum, ambulatory legs and dactylus, (2) shorter second cheliped, (3) thicker eyes, (4) propodus unarmed with equidistant setae along its posterior margin and (7) a larger number of upper rostral spines.

Leander longicarpus Stimpson

Leander longicarpus, Stimpson, 1860, p. 41; Kubo, 1941, pp. 308–310, Pl. 1, fig. 1 and Text-fig. 3.

The present species has of late been studied by the writer on the basis of many specimens obtained from Riu Kiu Islands as quoted above. Some additional descriptions will be given as to eye, mouth-parts, abdominal appendages, egg and others in the following lines.

Eye very similar to that of *Leander pacificus* Stimpson in outline, 1.2 times as long as wide; cornea slightly wider than stalk, occupies distal about half of eye, both inner and outer corneal lobes well developed (Fig. 24, *F*). Maxillule characteristically with comparatively longer inner lacinia which is as large as outer one; apical lobe of endopodite large. Second maxilliped nearly allied to that of *L. pacificus*, but the basal outer lobe of exopodite somewhat broader than that of the above-mentioned species (Fig. 22, *F*). Third maxilliped particularly slender as shown in Figure 23, *F*, reaches to about one-third of scaphocerite, proportions against last segment: penult 1.4, antepenult 2.0; last joint pointed, penult and antepenult ones about 11 times as long as wide respectively. Third pereiopod hardly reaches to distal margin of antennal scale, posterior margin of protopodite armed with several equidistant setae (Fig. 26, *F*). Fifth leg very slender, extends beyond the scale under the consideration by entire dactylopodite; propodus three times as long as last segment, posterior margin without spine but fringed with rather thickly set short setae in distal one-third (Fig. 26, *S*).

Endopodite of second abdominal appendage provided with very slender stylamblys and appendix musculina which is much longer than the former and sparsely fringed with rather long setae along outer and distal margins in male (Fig. 28, *E*), but in the other sex, it bears stylamblys only (Fig. 28, *N*).

Eggs nearly as large as that of *L. pacificus*, varying from 0.60~0.67 mm in longer axis (0.65 mm on average), 0.45~0.52 mm in shorter axis (0.49 mm on average).

Distribution: Hong Kong (STIMPSON); Sonai, Iriomote-zima, Riu Kiu (KUBO).

Leander longipes ORTMANN

Leander longipes, ORTMANN, 1890, p. 519, Taf. 37, fig. 13; DE MAN, 1907, pp. 409~411, Pl. 32, figs. 26~30; BALSS, 1924, p. 50 (in list).
Palaemon ortmanni, RATHBUN, 1902, p. 53 (in foot-note).

DE MAN (1907) has precisely described this species basing on an ovigerous female specimen, 58 mm long including rostrum, secured from Inland Sea of Japan. But supplementary description and remarks will be given in the following lines.

Eye intimately related to that of *L. macrodactylus*, about 1.6 times as long as wide measured at base of cornea, cornea semispherical, slightly wider than stalk, covers distal two-fifths of eye, both inner and outer corneal lobes rather developed (Fig. 24, *G*). Antennular peduncle three-segmented; basal segment depressed, subrectangular in upper aspect, somewhat more than twice as long as wide; stylocerite rather large, reaching about middle of the joint, outer antero-lateral angle armed with a large spine; second joint about one-third as long as, and somewhat more than half as wide as, basal one, about 1.4 times as long as wide; third one longer (ca. 1.3 times) than second segment; but as wide as second one; carries inner thinner and outer thicker flagella, inner one about 2.5 times of carapace, but outer one decidedly longer (ca. 3.3 times as long as carapace) than the other one, proximally uniramous comprising about 11 joints, but distally biramous with inner shorter and outer (ca. 7.5 times as long as shorter one) branches (Fig. 24, *R*). Antennal scale narrow, resembling that of *L. pacificus*, with almost straight outer margin, ending in a sharp spine which does not reach as far forward as rounded apex of lamella, about four times as long as wide measured at middle (Fig. 23, *R*). Maxillula closely allied to that of *L. gravieri*, but apical lobe of endopodite smaller (Fig. 19, *R*). Third maxilliped stout, extends to about middle of antennal scale, penult segment 1.4, antepenult one 1.8 in proportion to last segment; terminal segment pointed, penult

one about five times as long as wide as in the cases of *L. pacificus*, *L. macrodactylus* and *L. gravieri* (Fig. 23, *G*). Endopodite of second pleonic appendage provided with slender stylamblys and appendix masculina which is longer than the former and fringed with rather long setae along outer and apical margins in male (Fig. 28, *F*), but bar-shaped appendix interna only in female (Fig. 28, *O*). These appendices of male closely resemble those of *L. pacificus* and *L. macrodactylus* in configuration.

Described from a male, 37.5 mm long and a female, 44.0 mm in body-length. Additional specimens including 10 females measuring 24.3~56.0 mm long without rostrum were also examined. All specimens were collected from the vicinity of Kominato, Tiba Prefecture.

Locality: Kominato, Tiba Pref.

Distribution: Sagami Bay (Ortmann, 1891); Inland Sea of Japan, (de Man, 1907); Sagami Bay; Tsushima; Inland Sea; Amoi, China (Balss, 1924).

Note: This shrimp is commonly found on rocky shore, though de Man (1907, p. 409) mentioned it as a rare species.

The specimens of which the present investigation is based are closely allied in general characters to de Man's and Ortmann's descriptions and

Table 17.

Items	*L. longipes*	*L. longicarpus*
1. Body	Rather large	Small.
2. Rostrum	Armed with $\frac{7\sim9+2\sim3}{7\sim9}$ spines.	Armed with $\frac{4\sim6+1}{5\sim7}$ spines.
3. Antennal scale	4 times as long as wide.	3.5 times as long as wide.
4. Third maxilliped	Penult joint ca. 4.3 times as long as wide.	Penult segment ca. 11 times as long as wide.
5. Second pereiopod	Finger as long as palm, carpus somewhat longer than palm.	Finger shorter than palm, carpus somewhat more than 3 times as long as palm.
6. Third pereiopod	Propodus ca. 16 times as long as wide; dactylus shorter, ca. ⅓ times as long as propodus.	Propodus ca. 19.4 times as long as wide; dactylus longer, ca. 2/5 times as long as propodus.
7. Fifth pereiopod	Propodus ca. 19 times as long as wide; ca. 4 times as long as dactylus; armed with several equidistant setae along posterior margin.	Propodus ca. 29 times as long as wide; ca. 3.3 times as long as dactylus, not armed with equidistant setae along posterior margin.
8. Telson	Ca. 11 times as long as wide between posterolateral angles.	Ca. 13 times as long as wide between postero-lateral angles.
9. Sixth pleonic segment	Short.	Long.

figures of this species. But, the second pereiopod is longer; as it extends beyond tip of rostrum, at least, by entire chela in the largest specimen, 78.5 mm (16 mm in carapace) long including rostrum at my disposal instead of being "as far forward as the roptrum" as in DE MAN's specimen, 58 mm in total length.

No such example with unequal second chelipeds as described by DE MAN (1907, p. 410) was found among the specimens under my examination. Thus, it appears to me that the smaller cheliped DE MAN's specimen is probably a regenerated one as is sometimes the case with most macrurous crustaceans.

The number of rostral spines varies from 7~9, but is mostly 8, in both proximal series on upper and lower borders, but 2 or 3 in upper subterminal series.

The present species exhibits very close resemblance to *L. longicarpus*, but it may be easily recognized from the latter species by a number of

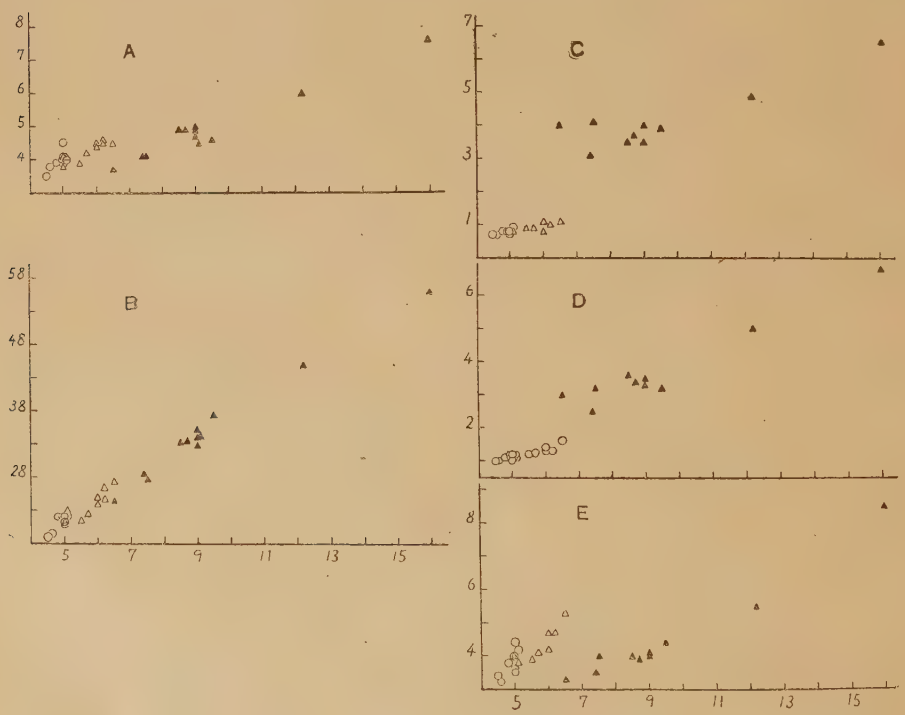

Fig. 13. Length (in mm) of sixth pleonic segment (*A*), body-length without rostrum (*B*), finger of second pereiopod (*C*), palm of second pereiopod (*D*) and carpus of the leg in question (*E*) in relation to carapace-length (in mm). Solid marks, *L. longipes;* soft marks, *L. longicarpus;* circles, male; triangles, female.

important characters as given in the Table 17.

Further, the present species and *L. longicarpus* are sharply defined from each other in the following relative lengths in relation to carapace, viz., finger, palm and carpus of second thoracic leg and sixth abdominal segment as shown in the accompanying graphs (Fig. 13).

Leander modestus Heller

Leander modestus, Kemp, 1917, pp. 221~223, Pl. 9, fig. 1; 1918, p. 268; Yu, 1930, pp. 558~559; Kubo, 1940, pp. 271~273, figs. 1 and 2; Uéno, 1935, pp. 274~276, figs. 3 and 4.
Leander macrogenitus Yu, 1930, pp. 559~561, fig. 1, A~C.

Some descriptions supplementing Kemp's (1917) one and some discussions will be given in the following paragraphs.

Eye rather slender, about 1.8 times as long as wide measured at base of cornea; cornea rather remarkably swollen, covers a little less than anterior half of eye, both inner and outer corneal lobes rather developed (Fig. 24, *I*). Scaphocerite broad, subrhombic, about three times as long as wide (Fig. 23, *T*). Maxillule closely resembles that of *L. macrodactylus*, inner endite and endopodite subequal in size, apical lobe of endopodite large (Fig. 19, *T*). First maxilliped provided with two-lobed epipodite which is distally bluntly pointed. Third maxilliped rather stout, proportions against last segment: penult 1.5, antepenult 1.9; penult one about 6 times as long as wide. Propodus of third leg armed with several equidistant setae along posterior margin (Fig. 26, *K*). Endopodite of second pleonic appendage with a bar-shaped appendix interna and an appendix masculina, the latter one somewhat longer than the former one and provided with a bunch of rather long setae in male, but with slender appendix interna only in female (Fig. 28, *G* and *Q*). Telson a little less than 4 times as long as wide measured at the proximal widest region and about 14 times as long as wide between postero-lateral angles; dorso-lateral margin with two pairs of bristles; proximal pair situated at about two-thirds and the other one about one-fifth (Fig. 29, *H*).

Egg very large, subglobular, 1.42~1.56 mm in longer diameter, 1.48 mm on average; 1.13~1.25 mm in shorter one, 1.18 mm on average. The ova were removed from a specimen measuring 37.0 mm long obtained from Harbin, Manchukuo.

The description mentioned above is made on the basis of a male specimen, 34.7 mm long. Three males and 11 females ranging from 27.0 mm to 43.1 mm in body-length also came under my examination. Most specimens excluding ovigerous ones were collected from Tung-ting Hu (Yochow), China,

and from the lower stream of River Rakutôkô, Korea by Mr. Taturokurô ISIWATA.

Distribution: Shanghai (KEMP, 1917); Shanghai; Pai-chü; Hangchow; Soochow; Ihing; Kingkiang (YU, 1930); Zitugetutan, Formosa (UÉNO, 1935); Dalai Nor; Lake Khanka, Manchoukuo (KUBO, 1940).

Note: The rostral spines vary from 6 to 8 on upper and from 2 to 4 on lower border (Table 18). That the rostrum is distally very shallow, simply pointed without exception and the first maxilliped carries two-lobed, apically rounded epipodite separates the present species from *L. mani* SOLLAUD (YU, 1930, p. 560, fig. 1, *C'* and KEMP, 1917, p. 223).

The appendix masculina is distinguished from that of other species shuch as *L. serrifer, C. pacificus, L. macrodactylus, L. gravieri, L. longipes* and *L. longicarpus* by having no long setae along its outer margin.

The specimens at my disposal tally almost completely with the KEMP's (op. cit.) description but differs in one point as given in the following table:—

Item	KEMP's description*	Present specimen
Fifth leg	Dactylus longer than carpus and the carpus is about three-sevenths the length of the propodus.	Dactylus slightly shorter than carpus which is about one-third the length of propodus (Fig. 25, *U*).

* KEMP, 1917, p. 222.

This descrepancy appears, however, to be nothing but fluctuation within one species.

Manchurian specimens which are already studied by the writer (KUBO, 1940, p. 271) stand at variance with the present specimens from Korea in the following characters, e.g., (1) the second pereiopod extends beyond the tip of rostrum by greater part of its finger; and (2) the pleonic appendages are long.

Peculiar as they are in representing young stage of my material in rostrum and in being small but ovigerous in one of them, UÉNO's (1935) specimens obtained from Riuran-tan and Zitugetu-tan, Formosa, are referred to the present species together with my material from Korea, Manchukuo, and China.

Leander macrogenitus was distinguished from the present species by YU (1930, pp. 559~561) by having the rostral formula 9/5, posterior two upper rostral spines placed on carapace, and finger and palm of second pereiopod subequal in length. But such characters can not be of importance in demarcation of the two species as they are vairable as shown in table 18 and in my previous paper (KUBO, 1940, Table 1, p. 272).

Table 18.

Dimensions (mm) and counts of bodily parts of *L. modestus*. The first six specimens obtained from Korea and the rest, from Tung-ting Hu, China.

No.	Sex	B.L.	C.L.	R.L.	Length of pereiopods					Length of each segment of second leg					Number of rostal spines	
										ischium	merus	carpus	palm	finger	upper	lower
1	♂	34.7	8.5	10.0	11.0	14.6	13.5	16.0	17.3	3.1	3.2	4.0	2.8	2.0	7	4
2	♀	36.4	9.0	10.0	12.3	17.3	15.3	17.7	20.6	4.0	4.0	4.2	2.0	2.2	8	4
3	»	36.4	9.0	10.3	13.2	17.0	14.8	17.7	19.0	3.8	3.8	3.9	2.3	3.0	6	3
4	»	27.0	6.0	6.9	9.2	12.0	11.2	12.7	15.1	2.6	2.6	3.0	1.5	1.8	7	3
5	»	35.0	9.1	10.0	13.0	16.4	15.1	17.3	19.5	3.6	3.6	4.2	2.1	2.5	8	4
6	»	31.0	8.4	8.5	10.0	12.9	12.5	14.7	16.0	3.0	3.0	3.1	1.6	2.0	7	2
7	♂	39.2	10.2	11.0	14.0	18.8	17.0	19.5	—	4.1	4.0	5.1	2.1	2.5	11	3
8	»	34.1	8.8	10.0	12.0	15.6	14.8	16.5	18.2	3.1	3.5	4.0	2.0	2.1	9	3
9	»	35.5	9.0	9.9	12.2	16.3	14.2	16.3	18.0	3.2	3.5	5.0	1.9	2.1	9	3
10	♀	43.1	11.5	14.9	—	—	—	—	—	5.0	5.1	—	—	—	9	3
11	»	36.5	10.0	—	13.7	18.0	16.0	19.0	20.9	4.0	4.1	4.8	2.2	2.4	10	3
12	»	—	10.0	11.1	14.0	20.0	16.1	18.8	—	4.0	4.4	5.1	2.2	2.5	9	4
13	»	41.6	11.0	12.4	15.0	21.0	16.5	—	22.5	4.0	4.6	5.5	2.4	2.5	8	4
14	»	35.6	10.9	11.5	13.2	18.3	15.6	18.5	—	4.0	4.0	5.0	2.0	2.5	9	3
15	»	34.5	9.2	10.0	13.2	17.6	—	17.4	19.0	3.6	3.7	4.5	2.0	2.4	7	2

B.L., body-length; C.L., carapace-length; R.L., rostrum-length.

Leander japonicus Ortmann

Leander longirostris japonicus Ortmann, 1891, p. 519, Taf. 37, fig. 14; Doflein, 1902, p. 639.
Leander japonicus, Balss, 1914, p. 58; 1924, p. 50; Parisi, 1919, p. 77, Pl. 6, fig. 10; Yoshida, 1941, p. 28, Pl. 7, fig. 1.
Palaemon japonicus, Rathbun, 1902, p. 50.

Body rather large, shell smooth. Rostrum long, with low lateral carina, about 1.6 times as long as carapace, surpassing scaphocerite by half; distal about two-thirds very slender and bent obliquely upwards, but basal about one-third considerably deep with remarkably convex dorsal carina carying 7 spines, of which the hindmost one placed on carapace, tip bifid with a minute accessory tooth, lower border armed with 5 teeth. Infra-orbital spine smaller than branchiostegal. Abdomen dorsally rounded; sixth pleonic segment rather long, 1.8 times as long as wide measured at middle, somewhat more than half of carapace in length. Telson is of *styliferus*-type, about 4 times as long as wide measured at proximal broadest region, shorter

than uropods, about 1.2 times as long as sixth pleonic somite; dorsolateral margin armed with two pairs of setae, proximal pair stands at five-eights but the distal one at three-fourths; lateral margins provided with two pairs of closely set subterminal bristles (Fig. 29, *J*). Eye rather slender, considerably narrowed proximally; cornea much swollen, occupying distal two-fifths, with both inner and outer lobes well developed (Fig. 24, *J*). Antennular peduncle hardly reaches to tip of antennal scale, basal segment depressed, subrectangular in outline, about half as wide as long; stylocerite rather small, scarcely reaching the middle of the basal segment; second segment rather short, about as long as wide, a little less than two-thirds as wide as basal joint; third segment longer (ca. 1.6 times) than second one, about 2.5 times as long as wide, bearing a pair of inner thinner and outer thicker flagella, inner flagellum much shorter than the outer one which is proximally uniramous with about 7 joints but distally divided into shotrer inner (about one-fourth times as long as carapace) and longer outer ramus (Fig. 24, *U*). Antennal scale broad, about two and half times as long as wide, with nearly straight outer margin ending in a stout spine which is far exceeded by distal margin of lamella (Fig. 23, *U*). Mandibular palp three-segmented, intermediate segment short, ca. 0.3 in proportion to terminal segment (Fig. 19, *J*). Maxillule intimately related to that of *L. modestus*, carrying rather large apical lobe on distal margin of exopodite (Fig. 19, *U*). First maxilliped has an exopodite with broad basal outer lobe as in the case of *L. longicarpus*, and two-lobed epipodite which is broadly rounded in distal margin (Fig. 21, *L*). Third maxilliped streaches somewhat beyond antennal peduncle, ratios against last segment: penult 1.4, antepenult 1.9; terminal segment pointed, penult one about seven times as long as wide; antepenult segment markedly bent with concave side directed towards median line (Fig. 23, *P*). First thoracic leg the shortest of all pereiopods, reaches more or less beyond tip of scaphocerite, proportions of each segment against movable finger: palm 1, carpus 3.8, merus 3, ischium 1.8; prehensile edges of chela straight, unarmed; tips of both fingers pointed, strongly recurved inwards. Second thoracic leg the longest and stoutest of all legs, extends beyond antennal scale by entire chela; fingers much longer than palm, about 1.4 times as long as palm, with straight, unarmed cutting edges and strongly inturned pointed tips; palm about three times in female and 2.5 times in male as long as wide; carpus 1.4 times as long as finger, distally a little dilated; merus ca. 1.2, ischium about 1.1 times as long as movable finger, about 14 times as long as wide (Fig. 25, *L* and *L'*). Third leg somewhat longer than first leg, reaches to about three-fourths of scaphocerite, ratios to dactylus: propodus 1.7, carpus 1, merus 3; dactylus long, simply

acuminated at tip; propodus ca. 16 times as long as wide, posterior margin provided with many equidistant setae (Fig. 26, *L*). Fourth leg more or less longer than third one, propodus 2.1, carpus 1, merus 2.2 in proportion to dactylus. Fifth one closely related to fourth one in general aspect but somewhat longer than fourth leg, extends beyond tip of scaphocerite by whole dactylus, ratios to dactylus: propodus ca. 3.1, carpus 1.5, merus 3; propodus with rather thickly set short setae along distal one-third of posterior margin (Fig. 26, *V*). Endopodite of second abdominal appendage nearly allied to that of *L. modestus* in either sex respectively (Fig. 28, *H* and *S*).

Eggs subspherical, measuring 0.52~0.58 mm in longer axis (0.55 mm on average), 0.41~0.46 mm in shorter diameter (0.44 mm on average in those separated from a specimen, 35 mm in body-length secured from Hukuyama, Hirosima Prefecture.

Young: Rostrum reaches a little beyond tip of antennal scale. Second cheliped hardly reaches or somewhat beyond tip of scaphocerite, finger subequal to, or slightly longer than palm. Fifth pereiopod the longest of all ambulatory legs, but scarcely reaches to distal margin of antennal scale. Sixth abdominal segment rather long, about two-thirds as long as carapace and one and half times as long as wide. Telson shorter than uropods, closely resembles that of younger specimens of *Leander styliferus* Milne-Edwards (*Leander* sp., Kemp, 1908, p. 221), about 3.5 times as long as wide measured at proximal widest region in a specimen, 20 mm long (Fig. 14, *B*), but about 3.6 times as long as wide in another specimen, 26.2 mm long (Fig. 14, *A*); dorsolateral margins armed with two pairs of setae, the proximal pair placed at about one-third and the other one at about one-sixth; terminal margin triangularly pointed, provided with two pairs of outer shorter and inner longer bristles, the inner setae extend beyond the tip by its distal half in the specimen, 20 mm long, but slightly beyond the tip in the specimen, 26.2 mm in body-length (Fig. 14, A).

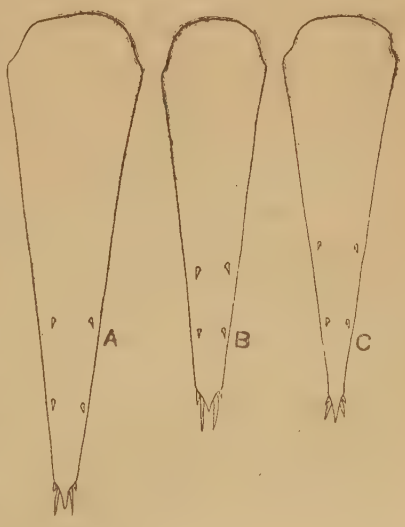

Fig. 14. Dorsal view of telson. *A*, *L. japonicus*, ♀, 26.2 mm in body-length (6.4 mm in carapace), ×15; *B*, *L. japonicus*, ♂, 20.0 mm (4.2 mm), ×20; *C*, *L. carinatus*, ♂, 33.5 mm, ×15.

The above-mentioned descriptions are based on two males, 46.0 mm and 26.2 mm long and 14 females (9 ovigerous), ranging 20.0～68.0 mm long, secured from various localities of Japan including Korea.

Locality: Fukagawa, Tokyo; Lake Hamana and Yosida, Siduoka Pref.; Tarumi, Hyôgo Pref.; Hukuyama, Hirosima Pref.; Husan, Korea.

Distribution: Tokyo Bay (ORTMANN, 1891); Matusima, Miyagi Pref.;

Table 19.

Items	*L. japonicus*	*L. styliferus*
1. Rostral formula	$\frac{7\sim10+0\sim2}{5\sim8}$	$\frac{5\sim7+0\sim5}{6\sim10}$
2. Size of egg in mm	0.52～0.58 × 0.41～0.46	0.65～0.82 × 0.56～0.61
3. Carpus of second pereiopod	About 1.4 times as long as merus or finger	Considerably shorter than merus or finger
4. Relative growths of second leg and merus, palm and finger of the same leg	Smaller	Larger

Table 20.

Measurements of bodily-parts and counts of rostral spines of *L. japonicus* from various localities.

No.	Sex	B.L.	C.L.	R.L.	Length of pereiopods					Length of each segment of 2nd leg				3rd leg		Number of rostral spines	
					1st	2nd	3rd	4th	5th	D	E	F	G	F	G	upper	lower
1	♂	46.0	11.7	—	14.5	20.8	15.4	17.8	—	5.9	5.9	2.7	4.0	3.0	1.9	—	—
2	♀	61.0	15.0	—	20.0	32.0	24.0	27.5	30.0	6.8	8.0	4.5	5.5	5.5	3.5	—	—
3	”	61.0	15.0	25.0	20.0	31.0	21.0	26.0	29.0	6.5	7.6	4.5	6.0	4.9	3.0	7+1	5
4	”	68.0	17.5	27.0	23.5	32.0	25.0	29.0	—	7.0	7.5	4.3	6.2	4.5	3.0	7+1	5
5	”	63.0	16.9	26.0	—	32.5	—	27.0	—	6.8	8.0	4.9	5.0	—	—	7+1	5
6	”	60.0	16.0	26.4	21.2	32.6	—	25.6	—	6.9	8.0	4.5	5.9	—	—	7+0	5
7	”	54.9	13.6	21.1	19.2	26.2	20.0	23.8	26.0	5.5	6.2	3.0	5.0	4.4	2.7	8+1	7
8	”	49.6	13.0	22.5	16.9	—	—	—	—	—	—	—	—	—	—	8+1	7
9	”	51.5	13.5	19.6	17.8	—	18.1	23.0	25.0	—	—	—	—	4.5	2.5	7+1	6
10	”	49.5	12.7	—	16.1	—	—	20.9	23.3	4.9	5.9	—	—	—	—	—	—
11	”	59.0	15.0	21.3	19.8	31.9	20.4	24.5	27.0	6.8	7.1	4.1	6.9	5.0	2.5	7+1	6
12	”	51.0	13.1	18.1	16.1	22.0	17.0	20.5	22.2	4.6	5.6	2.5	3.5	4.1	2.1	7+2	8
13	”	32.0	8.2	11.5	9.5	13.1	11.5	13.6	14.0	3.0	3.0	1.6	2.0	2.8	1.1	7+1	5
14	”	34.6	8.7	11.9	12.2	15.3	12.2	14.9	16.9	4.0	3.9	2.0	2.6	2.9	1.9	10+1	8

B.L., body-length; C.L., carapace-length; R.L., rostrum-length; D, merus; E, carpus; F, propodus or palm; G, dactylus.

Enosima, Kanagawa Pref.; Kawatana and Nagasaki, Nagasaki Pref. (Rathbun, 1902); Hakodate, Hokkaidô (Doflein, 1902); Tsu, Mie Pref.; Tokyo; Takao, Formosa; Hankow (Balss, 1914).

Note: The present species is closely allied to *L. styliferus* Milne-Edwards (Kemp, 1917, pp. 250~252), but may be distinguished from the latter as shown in table 19.

As regards this species and *L. styliferus*, Rathbun (1902, p. 51) says that "*P. japonicus* (=*L. japonicus*) has no dorsal spines on the rostrum except at the base, . . ." and "the sixth segment of the pleon is nearly two-thirds as long as the carapace (rostrum excluded); in *P. styliferus* it is shorter, barely more than half the carapace." But the apical spines of this species and *L. styliferus* vary in number from zero to two (Table 20) and from zero to five (op. cit.) respectively; the sixth abdominal somite of adult form of this species is about one-half the length of carapace, but two-thirds when young.

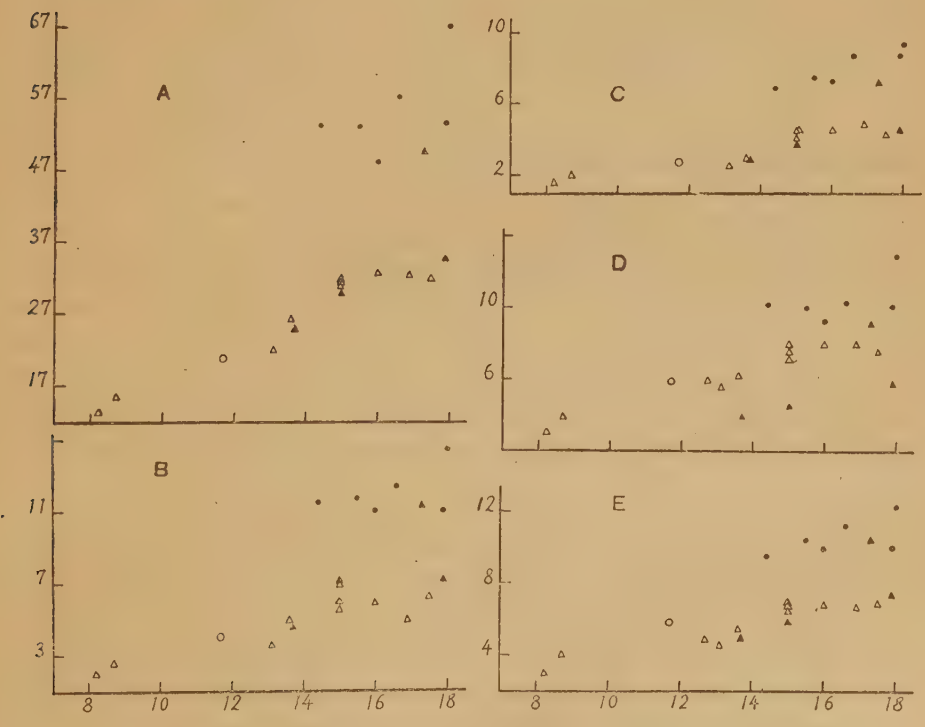

Fig. 15. Length (in mm) of second pereiopod (*A*), finger (*B*), palm (*C*), carpus (*D*) and merus (*E*) of second leg in relation to carapace-length (in mm). Solid marks, *L. styliferus;* soft marks, *L. japonicus;* circles, male; triangles, female.

It appears in Fig. 15, in which data of the present author as well as of KEMP (loc. cit.) are plotted, that the latter investigator's material includes two different forms, one coincident with, and the other discrepant with the present species in the relative growths of second pereiopod and merus, palm and finger of the same leg.

Remarkably enough, telson of the present species is of *styliferus*-type and it assumes this type at the time the animal is about 35 mm long without rostrum but it belongs to *paucidens*-type in younger stages. This fact suggests that *paucidens*-type is phylogenetically more primitive than *styliferus*-type.

Leander carinatus ORTMANN

Leander longirostris carinatus ORTMANN, 1891, p. 521.
Leander carinatus DOFLEIN, 1902, p. 639; PARISI, p. 77, Tav. 4, fig. 3 and Tav. 6, figs. 8 and 9; KEMP, 1917, p. 219, fig. 6 (a~d); URITA, 1926, p. 428; YU, 1930, p. 556; YOSHIDA, 1941, pp. 28~29, Pl. 7, fig. 2.
Leander styliferus carinatus BALSS, 1914, p. 57; 1924, p. 50.

Rostrum stout, long, with lateral carina, 1.3~1.5 times as long as carapace (Fig. 33, Lower), stretching beyond antennal scale by one-third; deep in proximal one-third but becomes very thin toward tip; dorsal crest armed with 6~9 teeth, extending backwards to about middle of carapace; ventral carina provided with 3~8 teeth; tip dorsally carries usually a tooth. Infra-orbital and branchiostegal spines present, but the former much smaller than the latter one. Third to sixth abdominal segments carinated along dorsal median line; sixth one a little more than half of carapace, about 1.5 times as long as wide measured at proximal widest region. Telson dorsally rounded; dorso-lateral margins armed with two pairs of setae, anterior pair standing at about two-thirds, but the other pair at ca. five-sixths; subterminal lateral margins with two pairs of setae set close together (Fig. 29, *K*). Eye rather slender, about 1.7 times as long as wide, distal one-third covered with cornea which is slightly wider than stalk and its inner and outer lobes rather developed; inner surface of stalk somewhat swollen (Fig. 24, *K*). Antennular peduncle reaches to two-thirds of antennal scale; basal segment subrectangular in upper aspect, about 1.3 times as long as (without protruding portion) as wide; stylocerite rather small, nearly reaching to middle of the segment; intermediate segment short, ca. 1.3 times as wide as long, about one-third the length of basal segment; ultimate segment about two and half times as long as penult one, provided with inner thinner and outer thicker rami; the inner one basally uniramous comprising about 8 joints, but distally bifid with inner shorter flagellum, which is ca. one-fourth times

as long as carapace, and outer longer flagellum (Fig. 24, *V*). Antennal scale rather broad, subrhombic, about three times as long as wide; outer margin nearly straight, ends in a short, stout spine which is greatly exceeded by rounded distal margin of lamella (Fig. 23, *V*). Mandible Y-shaped as usual; palp three-segmented, intermediate joint a little shorter than basal one, but about half as long as terminal one (Fig. 19, *K*). Maxillule and first maxilliped very similar to those of *L. japonicus*, but the basal outer lobe of exopodite of first maxilliped narrower than that of the said species (Fig. 19, *V*). Second maxilliped closely resemble that of *L. japonicus* in general appearance but slenderer than that of the latter (Fig. 22, *L*). Third maxilliped reaches to distal margin of second segment of antennular peduncle; penult segment ca. 1.5, antepenult one 2.0, times as long as last segment; terminal segment pointed, penult one about seven times as long as wide (Fig. 23, *Q*). First leg slender, the shortest of all pereiopods, proportions against movable finger: palm 0.4, carpus 3, merus 2.5. Second leg the stoutest and the longest of all legs; proportions to movable finger: palm 0.5~0.7, carpus 0.5~0.6, merus 0.8~1.1, ischium 1.0~1.2; fingers provided with unarmed straight cutting edges and pointed, strongly inturned

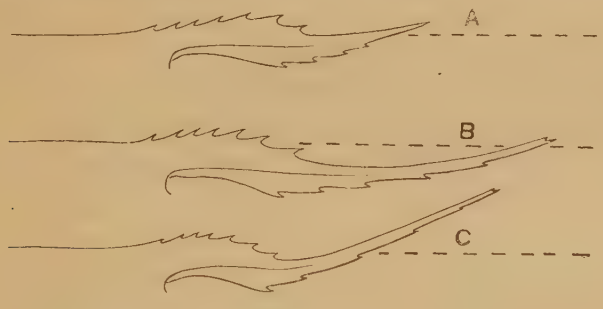

Fig. 16. Rostrums in profile. *A, L. modestus*, ♂, ×3.5; *B, L. carinatus*, ♂, ×3; *C, L. japonicus*, ♂, ×2.

tips; palm rather swollen, suboval in cross-section, 2.5~2.8 times as long as wide, both dorso-lateral margins bluntly carinated but proximally convergent into a single carina; carpus anteriorly enlarged, merus about ten times as long as wide (Fig. 25, *M* and *M'*). Third leg slightly longer than first one, reaches to anterior margin of antennular peduncle, proportions to dactylus: propodus 1.1, carpus 0.5, merus 2; dactylus styliform, slightly recurved backwards; propodus armed with 7~9 equidistant setae along posterior margin, about 11 times as long as wide (Fig. 26, *M*). Fourth leg longer than preceding one, reaches to, or slightly beyond, tip of scaphocerite, propodus 1.9, carpus 0.9, merus 2.2 in proportion to dactylus. Fifth

leg very similar to third and fourth ones in general aspect, but longer and slenderer than these legs, streaches somewhat beyond scaphocerite, ratios against dactylus: propodus 2.0~2.4, carpus 1.0~1.1; merus 2.0~2.2; propodus fringed with rather thickly set setae in distal one-third of posterior margin (Fig. 26, *W*). Endopodite of second abdominal appendage bears slender appendix interna and appendix musculina in male, but the former only in female. Appendix masculina slightly longer than stylamblys, fringed with several long setae on terminal margin (Fig. 28, *I* and *R*).

Young: A much mutilated male specimen, 33.5 mm long, without all thoracic legs but those of the first pair came under my examination. First pereiopods reach to tip of outer margin of scaphocerite. Telson (Fig. 14, *C*) about three and half times as long as wide measured at the proximal broadest region; each dorso-lateral margin with two setae, the anterior one situated at about three-fifths and the other one nearly at four-fifths; terminal margin ends in a large triangular process, provided with two pairs of outer smaller and inner larger bristles set close together, longer seta does not reach to tip of the median process. Appendix masculina bears several long setae on distal margin, slightly shorter than stylamblys.

Egg: Rather large, 0.70~0.81 mm in longer diameter, 0.75 mm on average; 0.53~0.60 mm in shorter diameter, 0.58 mm on average of ten eggs removed from a specimen 69.0 mm in body-length secured from Antô, Korea.

The description mentioned above is based on 44 males ranging 9.0~15.0 mm in carapace-length (33.5~58.0 mm in body-length) and 21 females (8 ovigerous), 8.8~17.0 mm in carapace-length (33.0~62.2 mm in body-length).

Locality: Gunzan, Korea.

Distribution: China (ORTMANN, 1891); Tsingtau (DOFLEIN, 1902); Tsingtao; Singapore (BALSS, 1914); Ningpo, China (KEMP, 1917); Shanghai (PARISI, 1919); Tsingtao (URITA, 1926); Pai-chii; Tsing-tao; Tien-tsin; Peitaiho; Chingwangtao (YU, 1930).

Note: The rostrum of the present species is nearly equal to that of *L. japonicus* in relative length against carapace-length as plotted in Figure 17, (*K*), but it is less recurved upwards than that of the latter species (Fig. 16, *B* and *C*). The rostral spines range 6~9 in upper ones, 2~8 in lower ones. The modal number is 7 on the upper and 5 on the lower. One subterminal spine is usually present, but sometimes is absent.

It is worthy of note that the relative growth of the first and second thoracic limbs against carapace-length is linear in trend, on the other hand, that of the last three pairs of ambulatory legs in non-linear and nearly asymptotic at the time the animal is about 15 mm in carapace-length (59.5

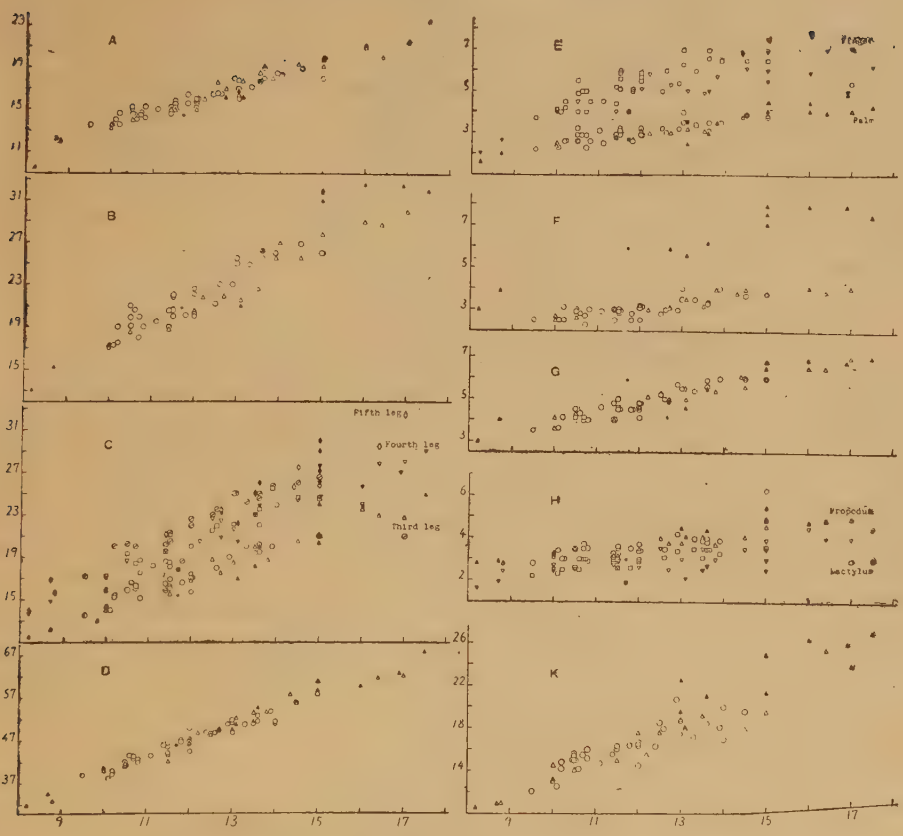

Fig. 17. Relative growth of first (*A*), second (*B*), third, fourth, fifth (*C*), body-length without rostrum (*D*) and finger, palm (*E*), carpus (*F*), merus (*G*) of second pereiopod, dactylus of third leg (*H*) and rostrum (*K*). Abscissa, carapace-length (in mm); ordinate, length (in mm) of each bodily parts. ▲, ▼ and ◆, ♂ and ●, ■ and ◗, ♀ of *L. japonicus;* ○, □ and ⊘, ♂ and △, ▽ and ◇, ♀ of *L. carinatus.*

mm in body-length). Of the characters noted above, none is sexually dimorphic except second pereiopod which is somewhat longer in male than in female.

Agreeing with descriptions and figures of Ortmann, Kemp, Parisi and Yu in general characters as it is, my collection does not include such large male specimens with long second pereiopod which extends "beyond antennal scale by the whole of the carpus and chela" as mentioned by Kemp (1917, p. 220).

This species is very closely allied to *L. japonicus* Ortmann but it is easily distinguished from the latter by having at least the following charac-

ters, viz., (1) the rostrum is less recurved upwards (Fig. 16, *B*); (2) carpus of second pereiopod short, about half as long as finger; (3) eye stalk is provided with convex inner margin; (4) third to sixth pleonic segments dorsally carinated along median line; (5) egg somewhat larger, 0.75×0.58 mm on average (0.55×0.44 mm in *L. japonicus*). More closely related to

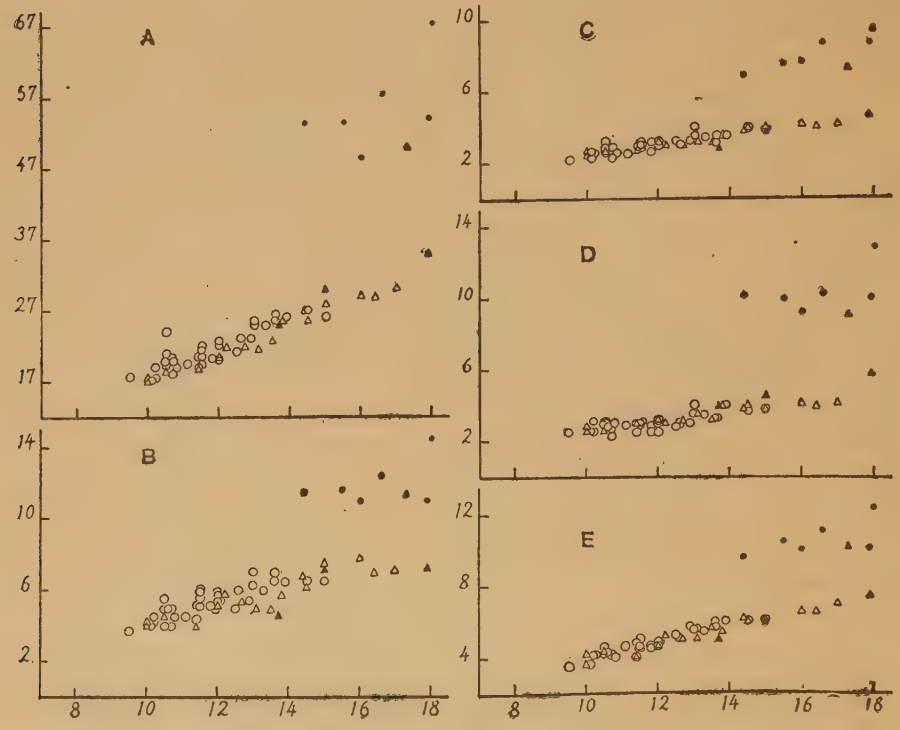

Fig. 18. Dimensions (in mm) of second pereiopod (*A*), finger (*B*), palm (*C*), carpus (*D*) and merus (*E*) of the leg in question in relation to carapace-length (mm). Solid marks, *L. styliferus;* soft marks, *L. carinatus;* circles, male; triangles, female.

L. styliferus MILNE-EDWARDS, but distinguished from it by smaller relative growth of second cheliped and merus, carpus, palm and finger of the same limb (Fig. 18).

Leander stylirostris YU

Leander annandalei stylirostris YU, 1930, pp. 460—462, fig. 4, C and P.

Carapace with moderately large branchiostegal and rudimentary infraorbital spines. Abdomen dorsally rounded; sixth pleonic somite about twice as long as wide, and about 1.7 times as long as fifth one (Fig. 31, Lower). Telson belongs to *paucidens*-type, about 0.8 times as long as cara-

pace, ca. 2.7 times as long as wide measured at the proximal widest region, shorter than uropods and slightly shorter than sixth abdominal segment; dorso-lateral margins armed with two pairs of setae, the proximal pair standing at five-sevenths and the other one at six-sevenths; terminal margin triangularly pointed, provided with two pairs of outer smaller and inner larger (about 4 times as long as outer one) bristles set close to postero-lateral angles (Fig. 29, *I*). Eye moderate, well pigmented; about 1.6 times as long as wide, cornea slightly wider than stalk; ocellus absent, both inner and outer corneal lobes not developed (Fig. 24, *H*). Antennular peduncle nearly reaches to the middle of scaphocerite; basal segment depressed, subrectangular in upper aspect, about 1.2 times as long as wide, stylocerite rather small, terminal spine on distal outer margin is rather minute; intermediate segment short, about one-third as long as basal one; last one somewhat more than twice of intermediate one, about half times as wide as intermediate one; provided with inner thinner and outer thicker flagella, the outer one basally uniramous with about 9 segments and again distally bifid with inner shorter and outer longer rami, the former ramus comprising 29 joints (Fig. 24, *S*). Antennal scale slender, distally narrowed, about four times as long as wide measured at the middle; outer margin straight, ending in a stout spine which is far exceeded by anterior margin of the lamella (Fig. 23, *S*). Mandible Y-shaped, with three-segmented palp; basal two segments of the palp subequal in length, last joint about two times as long as intermediate one (Fig. 19, *H*). Maxillule cross-shaped, inner and outer endites and endopodite subequal in size; apical lobe of endopodite rather large (Fig. 19, *S*). Maxilla with ear-shaped exopodite; endopodite papillary, unsegmented; inner distal lacinia rather slender, bifid in distal half with 2 lobes of equal size; inner proximal lacinia absent (Fig. 20, *H*). All maxillipeds provided with exopodite respectively. First maxilliped carries exopodite with rather broad basal outer lobe; endopodite thumb-like, unsegmented (Fig. 21, *H*). Third maxilliped nearly reaches to the middle of scaphocerite; ratios to terminal segment: penult 1.9, antepenult 2.1; ultimate joint simply pointed; penult one about seven times as long as wide; antepenult one thick and remarkably swollen in distal half (Fig. 23, *N*). First pereiopod does not extend to tip of scaphocerite. Second pereiopod the stoutest of all thoracic limb; ischium and merus subequal in length and about 4.5 times as long as carpus. Last three pairs of legs very slender, very similar with each other in general configuration. Fifth leg with proportions to carpopodite: propodus 3.8, merus 6, ischium 5; in third and fifth legs but propodus 3, merus 2.5, ischium 2. Endopodite of second abdominal appendage carries a slender appendix interna or stylamblys and an appendix

masculina which is shorter than the other appendix and fringed with rather sparsely set setae on distal margin (Fig. 28, *J*).

The description mentioned above is based on a male specimen, 33.5 mm in standerd length excluding rostrum (8.6 mm in carapace-length), secured from Gunzan, Corea.

Distribution: Tangku, China (YU).

Note: Four items of difference between the present species and *Leander annandalei* KEMP regarding configuration of the rostrum and the second thoracic limbs have been pointed out by YU. But closer investigations have enabled me to add several differences as exhibited in the following table 21.

Table 21.

Items	*L. annandalei*, ♂.	Present species, ♂.
1. Branchiostegal spine	Fully grown and as large as the antennal spine.	Decidedly smaller than antennal spine.
2. Fifth leg	Dactylus has a slight basal swelling which is rather thickly clothed with short hairs.	Simple.
3. Telson	Bears a single pair of dorsal spinules near the distal end; the apex with a long lateral spinule on either side.	Provided with two pairs of spinules, the anterior pair stands at ca. 5/7 and the other one at ca. 6/7; the apex with two pairs of lateral spinules.

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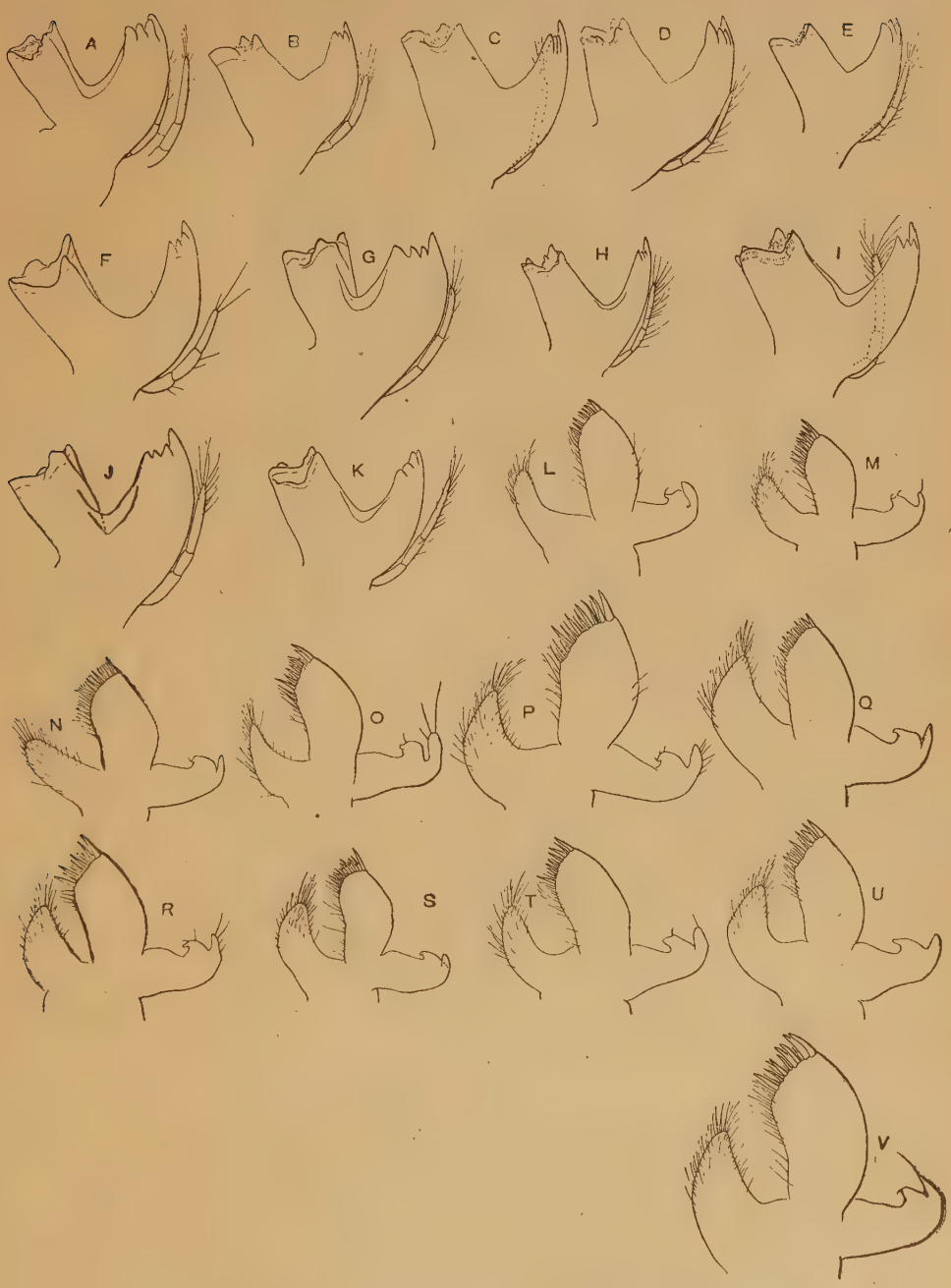


Fig. 19. Mandible (*A*~*K*) and maxillule (*L*~*V*). *A* and *L*, *L. paucidens*, ♂, 34.5 mm in body-length from Hukuyama, Hirosima Prefecture, ×16; *B* (×20) and *M* (×18), *L. pacificus*, ♂, 27.0 mm, from Kominato Tiba Prefecture; *C* and *N*, *L. serrifer*, ♂, ovigerous, 29.0 mm, from Kominato, Tiba Prefecture, ×20; *D* and *O*, *L. macrodactylus*, ♀, 31.8 mm, from Tokyo Bay, ×20; *E* (×ca. 8) and *P* (×12), *L. gravieri*, ♀, 50.5 mm from Korea; *F* adn *Q*, *L. longicarpus* ♀, ovigerous, 26.7 mm, from Sonai, Iriomote-zima, Riu Kiu Islands; *G* and *R*, *L. longipes*, ♀, 44.0 mm, from Kominato, Tiba Prefecture, ×16; *H* and *S*, *L. stylirostris*, ♂, 33.5 mm, from Korea, ×20; *I* and *T*, *L. modestus*, ♀ 35.5 mm, from Rakutôkô, Korea, ×20; *J* and *U*, *L. japonicus*, ♀, 59.0 mm, from Lake Hamana, Siduoka Prefecture, ×12; *K* (×ca. 8) and *V* (×12), *L. carinatus*, ♀, 65.0 mm, from Gunzan, Korea. The above mentioned specimens were exclusively used for preparing Figs. 19~24 and 26, 29.

Fig. 20. Maxille. *A*, *L. paucidens*, ×12; *B*, *L. pacificus*, ×18; *C*, *L. serrifer*, ×16; *D*, *L. macrodactylus*, ×16; *E*, *L. gravieri*, ×ca. 8; *F*, *L. longicarpus*, ×20; *G*, *L. longipes*, ×12; *H*, *L. stylirostris*, ×16; *K*, *L. modestus*, ×16; *L*, *L. japonicus*, ×ca. 8; *M*, *L. carinatus*, ×ca. 8.

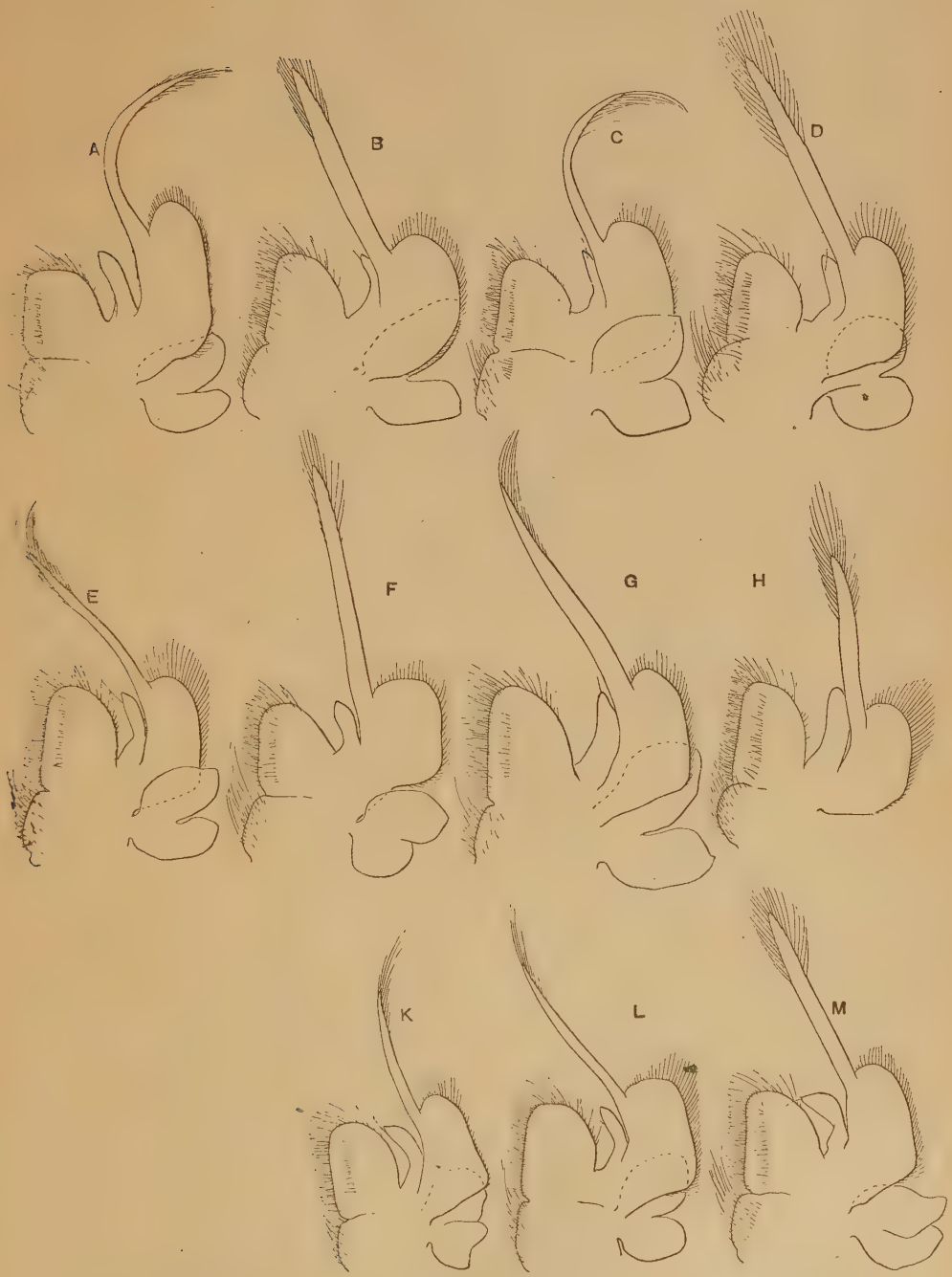


Fig. 21. First maxilliped. *A, L. paucidens,* ×12; *B, L. pacificus,* ×18; *C, L. serrifer,* ×16; *D, L. macrodactylus,* ×16; *E, L. gravieri,* ×ca. 8; *F, L. longicarpus,* ×20; *G, L. longipes,* ×12; *H, L. stylirostris,* ×16; *K, L. carinatus,* ×6; *L, L. japonicus,* ×ca. 8; *M, L. modestus,* ×16.

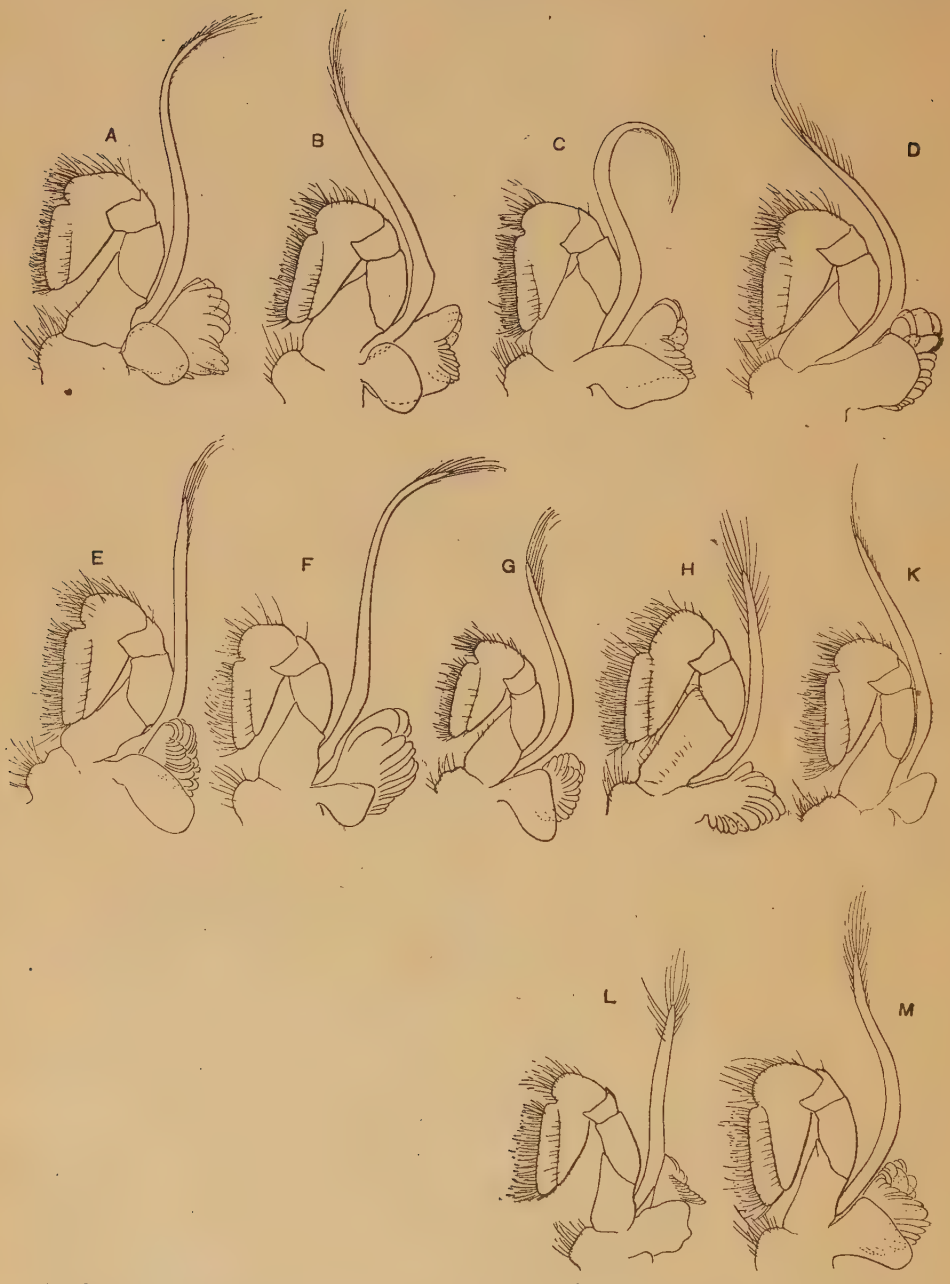


Fig. 22. Second maxilliped. *A, L. paucidens,* ×12; *B, L. pacificus,* ×18; *C, L. serrifer,* ×16; *D, L. macrodactylus,* ×16; *E, L. gravieri,* ×ca. 8; *F, L. longicarpus,* ×20; *G, L. longipes,* ×ca. 8; *H, L. stylirostris,* ×16; *K, L. japonicus,* ×ca. 8; *L, L. carinatus,* ×6; *M, L. modestus,* ×16.

Fig. 23. Third maxilliped (*A*~*G* and *N*~*Q*) and antennal scale (*H*~*M* and *R*~*V*). *A* (×ca. 8) and *H* (×6), *L. paucidens*; *B* (×ca. 8) and *I* (×6), *L. pacificus*; *C* (×ca. 8) and *J* (×6), *L. serrifer*; *D* (×ca. 8) and *K* (×6), *L. macrodactylus*; *E* (×ca. 4) and *L* (×ca. 3), *L. gravieri*; *F* (×12) and *M* (×6), *L. longicarpus*; *G* (×6) and *R* (×ca. 3), *L. longipes*; *N* and *S*, *L. stylirostris*, ×6; *O* (×ca. 8) and *T* (×ca. 5), *L. modestus*; *P* (×ca. 8) and *U* (×ca. 3), *L. japonicus*; *Q* (×ca. 5) and *V* (×2), *L. carinatus*.

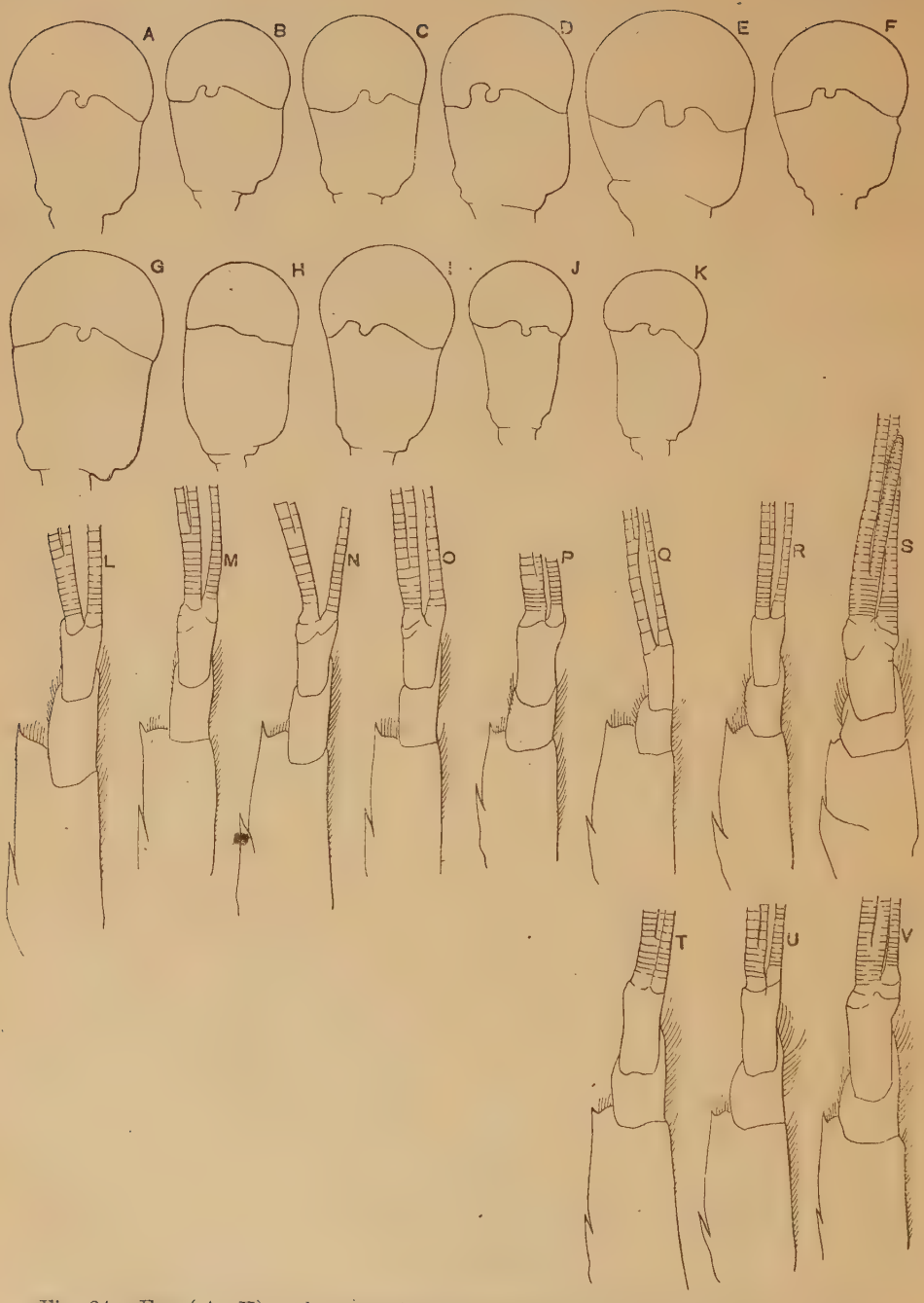


Fig. 24. Eye (*A*~*K*) and antennular peduncle (*L*~*V*). *A* (×12) and *L* (×ca. 8), *L. paucidens; B* and *M*, *L. pacificus*, ×6; *C* (×12) and *N* (ca. 8), *L. serrifer; D* (×12) and *O* (×ca. 8), *L. macrodactylus; E* (×12) and *P* (×ca. 5), *L. gravieri; F* (×12) and *Q* (×ca. 8), *L. longicarpus; G* (×12) and *R* (×6), *L. longipes; H* (×16) and *S* (×ca. 8), *L. stylirostris; I* (×12) and *T* (×ca. 8), *L. modestus; J* (×6) and *U* (×ca. 5), *L. japonicus; K* (×ca. 8) and *V* (×ca. 4), *L. carinatus.*

Fig. 25. Chelae of second pereiopod of male (*A*~*M*) and female (*A'*~*M'*). *A* (34.5 mm in body-length, ×12) and *A'* (45.0 mm long, ×ca. 8), *L. paucidens*, from Hukuyama, Hirosima Prefecture; *B* (37.5 mm, ×12) and *B'* (41.5 mm, ×ca. 8), *L. pacificus*, from Kominato, Tiba Prefecture; *C* (22.5 mm, ×20) and *C'* (29.5 mm, ×16), *L. serrifer*, from Kominato, Tiba Prefecture; *D* (27.5 mm, ×12) and *D'* (32.5 mm, ×ca. 8), *L. macrodactylus; E* (40.0 mm, ×ca. 8) and *E'* (50.5 mm, ×6), *L. gravieri*, from Zenrahokudô, Korea; *F* (23.5 mm, ×40) and *F'* (27.6 mm, ovigerous, ×28), *L. longicarpus; G* (37.5 mm, ×ca. 8) and *G'* (44.0 mm, ×6), *L. longipes* from Kominato, Tiba Prefecture; *H* (34.7 mm) and *H'* (34.5 mm), *L. modestus*, from Rakutôkô, Korea, ×16; *L* (43.0 mm, ×12) and *L'* (59.0 mm, ×6), *L. japonicus*, from Lake Hamana, Siduoka Prefecture; *M* (52.0 mm, ×6) and *M'* (53.0 mm, ×ca. 8), *L. carinatus* from Gunzan, Korea. The above mentioned specimens were exclusively used for preparing Fig. 28.

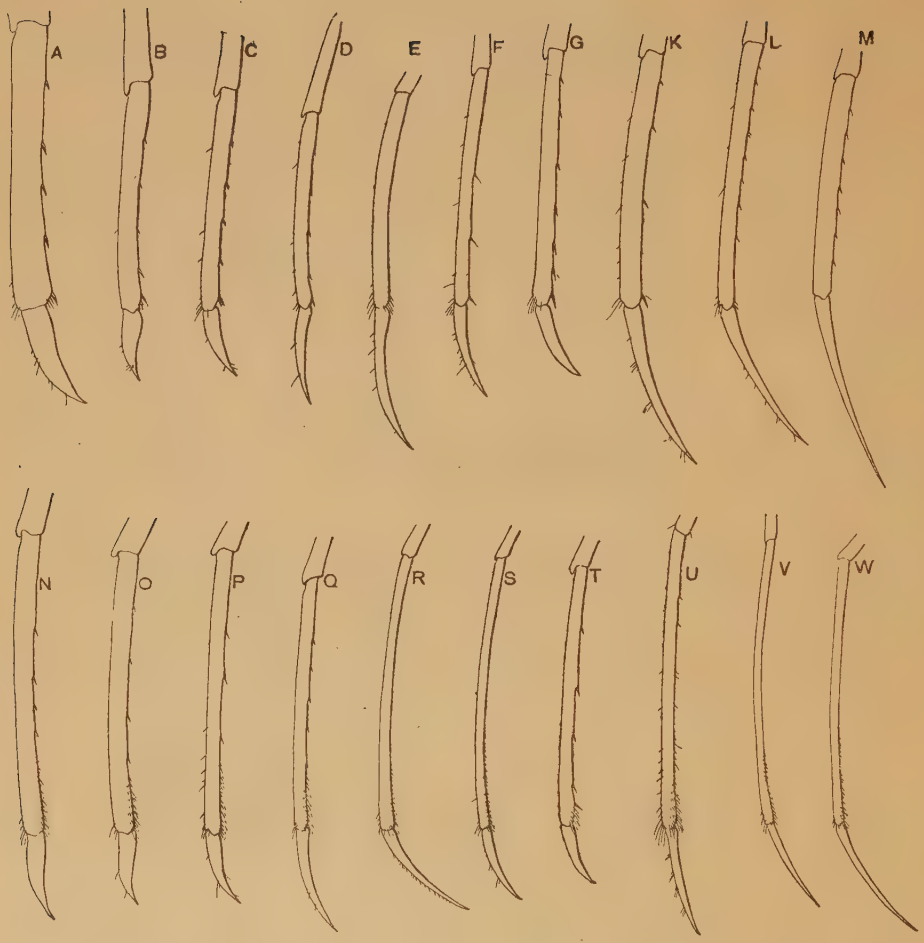


Fig. 26. Distal two segments of third (*A*~*M*) and fifth (*N*~*X*) pereiopods. *A* and *N*, *L. paucidens*, × ca. 8; *B* and *O*, *L. pacificus*, × ca. 8; *C* and *P*, *L. serrifer*, × ca. 8; *D* and *Q*, *L. macrodactylus*, × ca. 8; *E* (× ca. 5) and *R* (× ca. 3), *L. gravieri*; *F* and *S*, *L. longicarpus*, × 12; *G* (× 6) and *T* (× ca. 3), *L. longipes*; *K* (× 12) and *U* (× ca. 8), *L. modestus*; *L* (× ca. 8) and *V* (× ca. 3), *L. japonicus*; *M* (× ca. 5) and *W* (× ca. 3), *L. carinatus*.

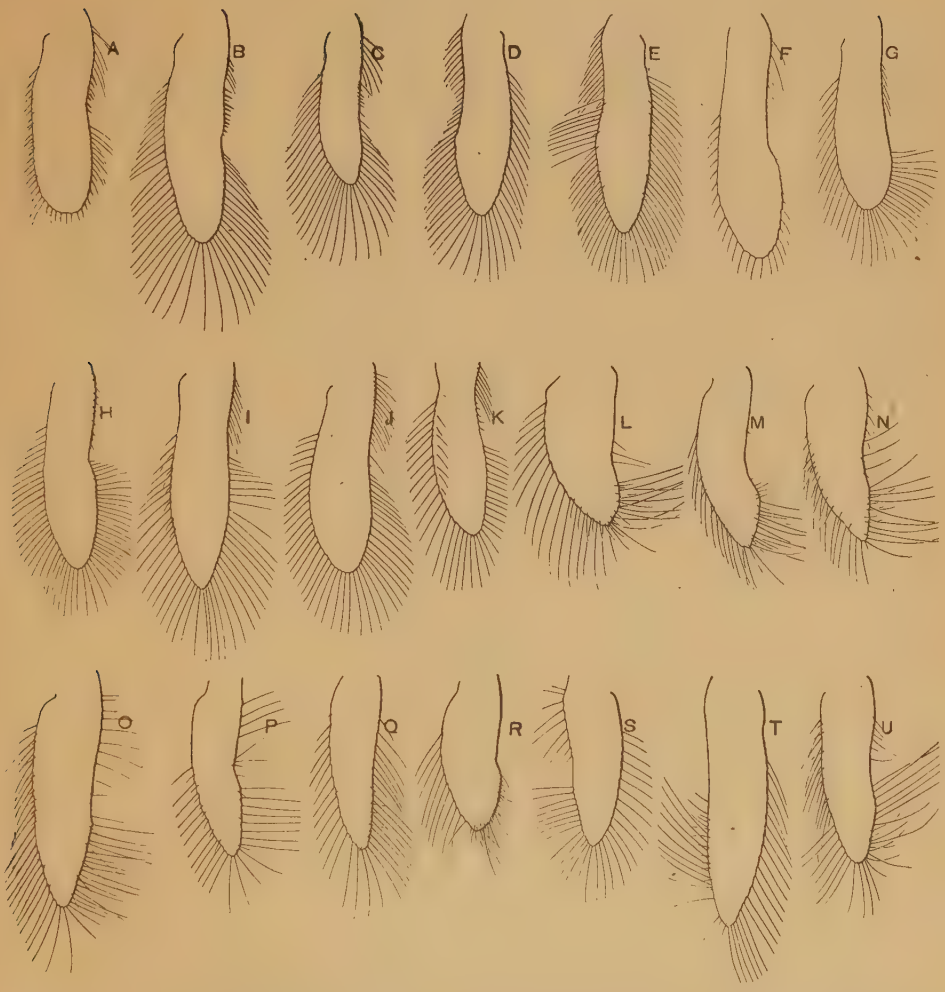


Fig. 27. Endopodite of first abdominal appendage of male (*A*~*K*) and female (*L*~*U*). *A* and *R*, *L. paucidens*, ×16; *B* (×16) and *L* (×20), *L. pacificus*; *C* (×20) and *M* (×ca. 8), *L. serrifer*; *D* (×20) and *N* (×28), *L. macrodactylus*; *E* and *O*, *L. gravieri*, ×12; *F* and *P*, *L. longicarpus*, ×28; *G* and *Q*, *L. longipes*, ×16; *H* (×16) and *S* (×20), *L. modestus*; *I* and *T*, *L. carinatus*, ×12; *J* and *U*, *L. japonicus*, ×12; *K*, *L. stylirostris*, ×28.

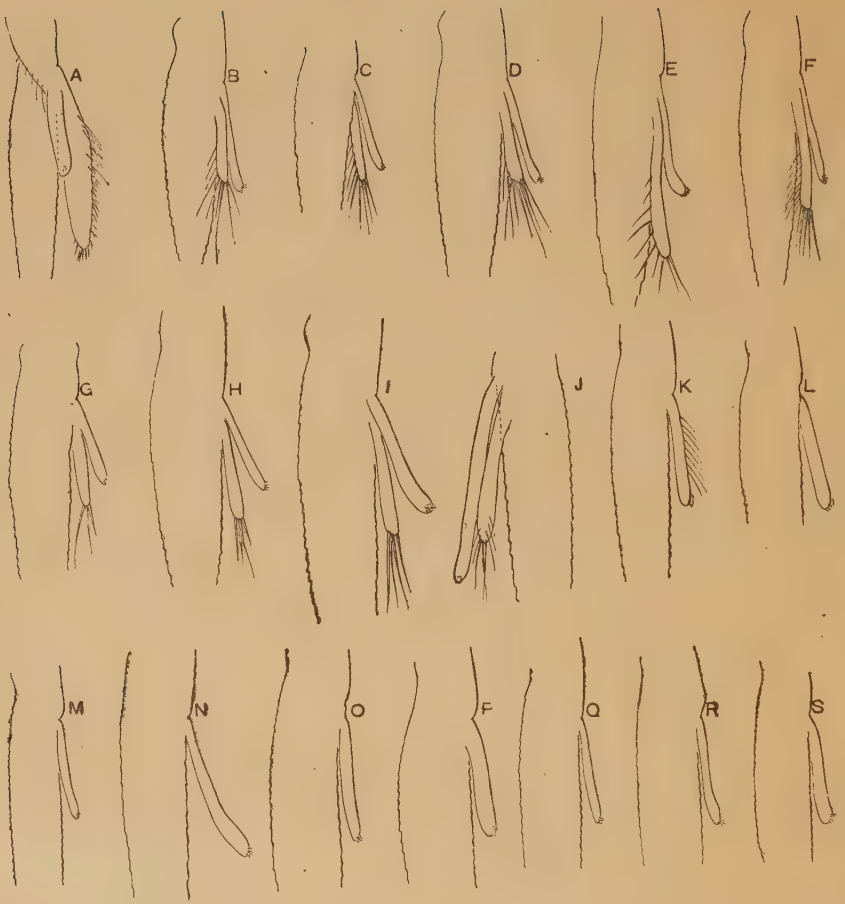
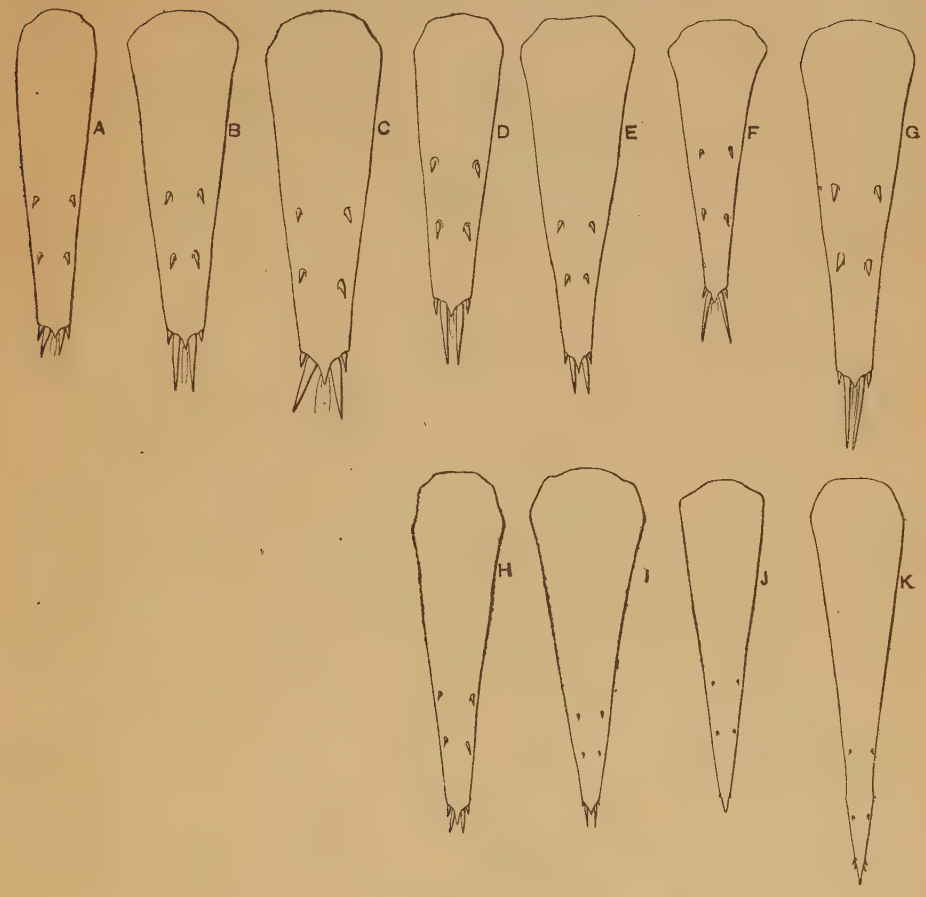


Fig. 28. Endopodite of second abdominal appendage of male (*A*~*J*) and female (*K*~*S*). *A* and *P*, *L. paucidens*, ×12; *B* and *K*, *L. serrifer*, ×20; *C* and *L*, *L. macrodactylus*, ×16; *D* (×12) and *M* (×ca. 8), *L. gravieri*; *E* and *N*, *L. longicarpus*, ×28; *F* (×12) and *O* (×16), *L. longipes*; *G* and *Q*, *L. modestus*; *H* and *S*, *L. japonicus*; *I* (×12) and *R* (×ca. 8), *L. carinatus*; *J*, *L. stylirostris*, ×16; *P*, *L. gravieri*, ×16.



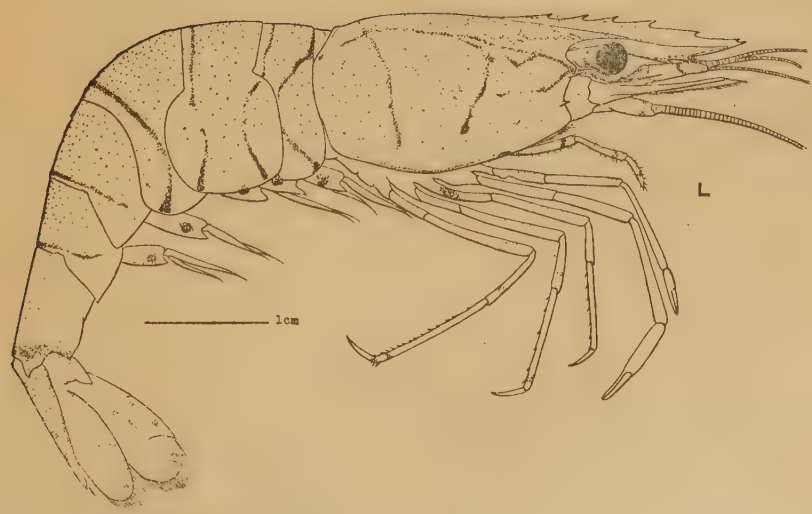


Fig. 29. Upper aspect of telson. *A, L. paucidens,* ×6; *B, L. pacificus,* ×ca. 8; *C, L. serrifer,* ×12; *D, L. macrodactylus,* ×ca. 8; *E, L. gravieri,* ×6; *F, L. longicarpus,* ×ca. 8; *G, L. longipes,* ×ca. 8; *H, L. modestus,* ×ca. 8; *I, L. stylirostris,* ×ca. 8; *J, L. japonicus,* ×ca. 3; *K, L. carinatus,* ×ca. 3; *L, L. paucidens,* female, from Saitama Prefecture.

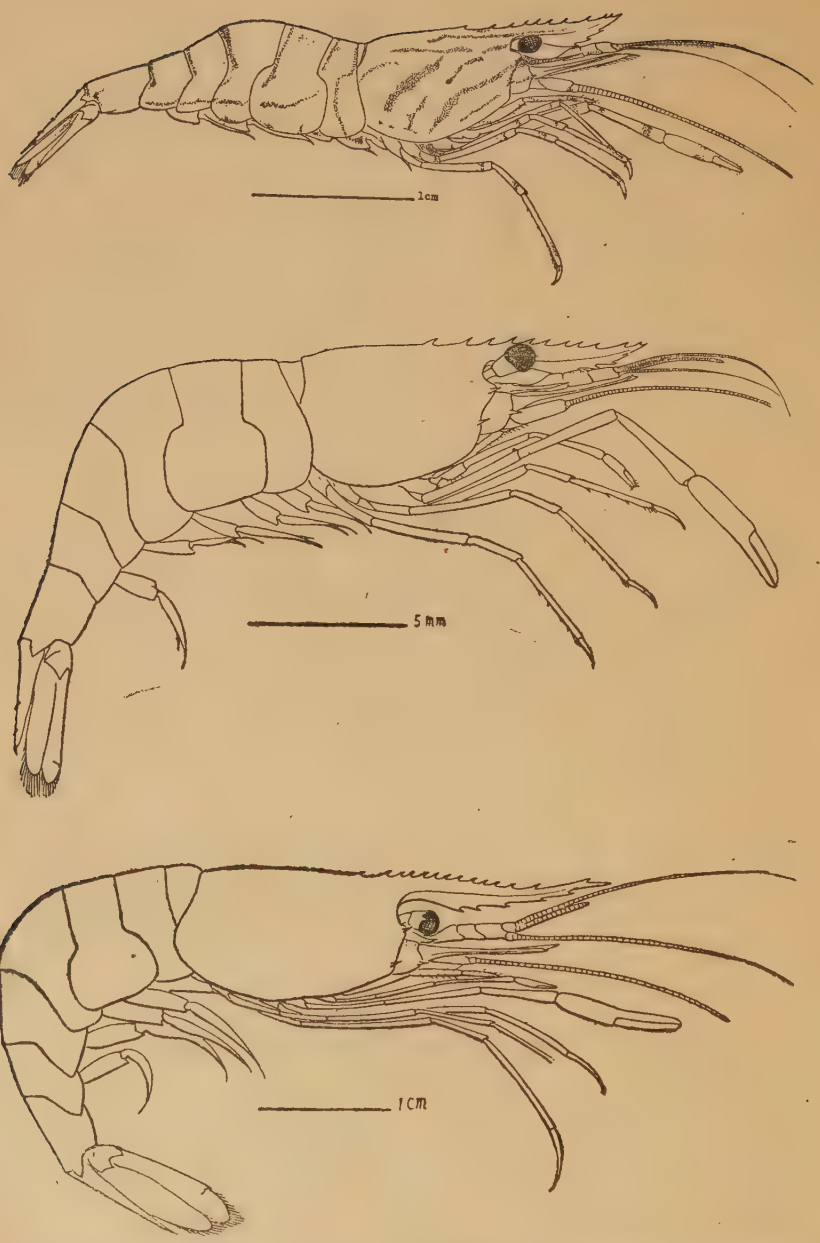


Fig. 30. Upper, *Leander serrifer* STIMPSON, female, from Kominato; Middle, *Leander macrodactylus* (RATHBUN), female, from Tokyô Bay; Lower, *Leander gravieri* YU, female, from Korea.

Fig. 31. Upper, *Leander pacificus* STIMPSON, young female, from Kominato; Middle, *Leander pacificus* STIMPSON, grown up female, from Kominato; Lower, *Leander stylirostris* YU, male, from Korea.

Fig. 32. Upper, *Leander longipes* ORTMANN, female, from Kominato; Lower, *Leander modestus* HELLER, male, from River Rakutôkô, Korea.

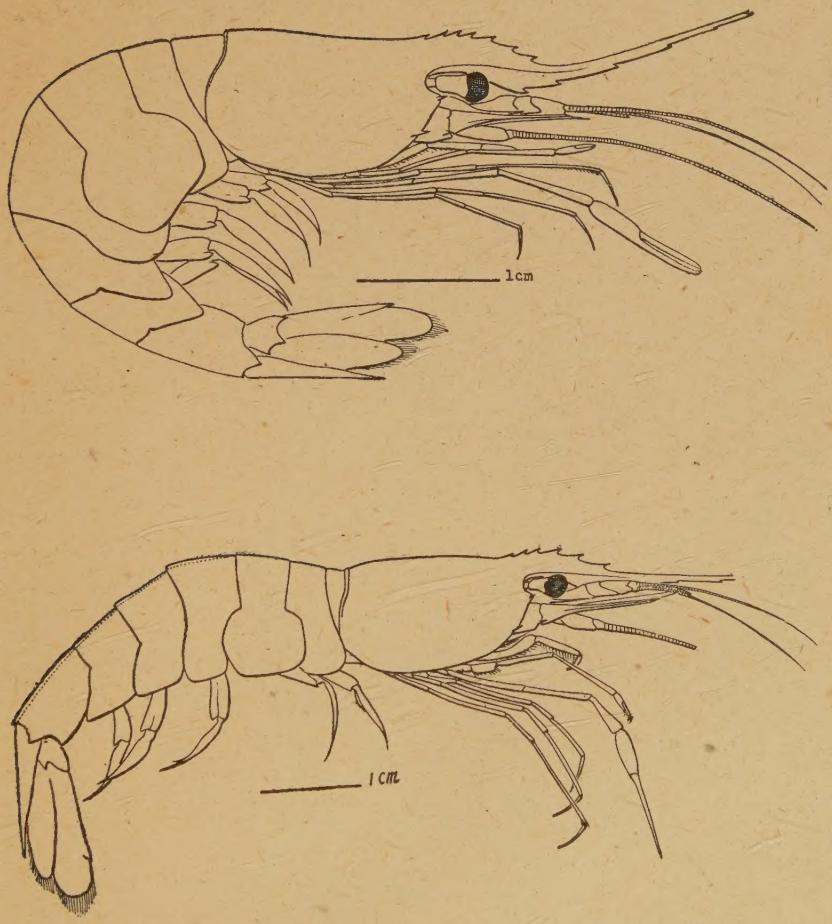


Fig. 33. Upper, female of *Leander japonicus* ORTMANN from Korea; Lower, *Leander carinatus* ORTMANN, female, from Korea.